01433

OPERATING MANUAL

930 A COMMUNICATIONS TEST SET

SAGE INSTRUMENTS

WARRANTY

The SAGE Instruments 930A is warranted to be free from defects in materials or workmanship for a period of one year from the date of shipment. During the warranty period, SAGE will, at its option, either repair or replace products which prove to be defective at SAGE's expense.

Any repairs for damages from accident, customer misuse, or improper repair by other than SAGE Instruments' technicians or their authorized service facilities are not covered by this warranty. All out of warranty repairs will be done at the customer's expense based upon time and materials.

SAGE Instruments warrants that firmware provided for the 930A will execute its programming instructions when properly installed. SAGE does not warrant the operation of the instrument to be continuous or error free.

If improper operation of the Model 930A is suspected, contact SAGE Instruments at (408) 662-3000. Upon verification of problem with Customer Service a Returned Material Authorization number will be issued for the instrument.

EXCLUSIVE REMEDIES

The remedies provided herein are the buyer's sole and exclusive remedies. SAGE Instruments is not liable for consequential damages or damages to any party other than the buyer. SAGE Instruments specifically disclaims any implied warranty of merchantability or fitness for a particular purpose. No other warranty is expressed or implied.

SHIPPING INSTRUCTIONS

After obtaining return authorization, ship the Model 930A, in its original container, postage prepaid, to:

SAGE INSTRUMENTS
311 Bonita Drive
Aptos, CA 95003
(408) 662-3000
ATTN: REPAIR

Include a detailed description of the problem and the conditions and circumstances under which the symptoms occured. If the original packaging is not used, be sure to pack the Model 930A carefully to prevent additional damage during shipping.

SAGE INSTRUMENTS
MODEL 930A
COMMUNICATIONS TEST SET

OPERATIONS MANUAL

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SECTION I
GENERAL INFORMATION

1-1 INTRODUCTION

This operating manual contains general information regarding the installation and operation of the SAGE Model 930A Communications Test Set. Figure 1-1 shows the instrument and optional accessories available.

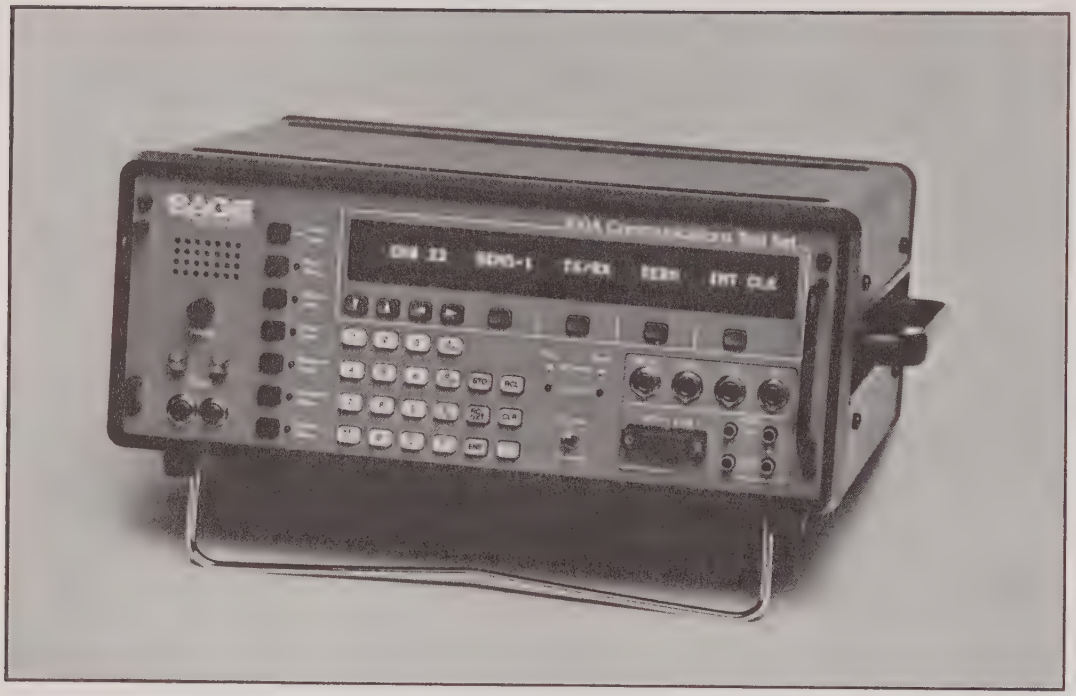
1-2 SPECIFICATIONS

The instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Options for the instrument have separate specifications which are provided on supplementary specification sheets.

1-3 DESCRIPTION

The Model 930A Communications Test Set combines the functions of a Transmission Impairment Set, a Return Loss Measurement Set, Dial Pulse, Touch Tone (DTMF) and Multi-Frequency (MF) Sender, and Talk Battery supply into one lightweight package. Hardware and software options allow the user to greatly increase the capabilities of the 930A. These options include:

DP, DTMF, MF Receiver/Analyzer with Trunk Simulation
DX Supervision
SF Supervision
P/AR Receiver/Transmitter
3-Level Impulse Noise
Digital Volt/Amp Meter
RS-232C Remote Control/Printer Interface
Automatic Identified Outward Dial(AIOD) Receiver/Transmitter
DS-1 PCM Transmit/Receive (Single or Dual Direction)
Type 105 ROTL Interrogator/Responder (52A Format)
Ring Generator/REN-3 Load
LTTP/STTP Interface
Phase Jitter Measurement (Future Option)
FXO/FXS Supervision (Future Option)
Non-Linear Distortion Measurement (Future Option)
Envelope Delay Distortion Measurement (Future Option)



MODEL 930A AND ACCESSORIES

FIGURE 1-1

The instrument, while general purpose in nature, is particularly useful for DEMARC and Central Office testing as well as PBX and digital switch installation testing. It is capable of performing all transmission and signalling tests required at these locations, including those for Feature Groups A-D (Equal Access). The Model 930A can completely simulate either a PBX or a Central Ofice switch. The procedures for making these measurements are described in Section III of this manual.

1-4 ACCESSORIES AVAILABLE

The following accessories are available:

1. 80 Column Dot Matrix Printer and Cable,
   SAGE P/N 9400-0001-01
2. Test Cord, bantam male to bantam male,96 inches
   SAGE P/N 9400-0002-01
3. Adapter , 310 male to bantam female,
   SAGE P/N 9400-0003-01
4. Standard 19-inch rack mounting kit,
   SAGE P/N 9400-1001-01
5. Standard 23-inch rack mounting kit,
   SAGE P/N 9400-1002-01
6. Padded Vinyl Carrying Case,
   SAGE P/N 9400-1003-01
7. Industrial Grade Shipping Case,
   SAGE P/N 9400-1004-01

1-5 WARRANTY

Warranty information is listed inside of the front cover.

TABLE 1-1 *Specifications*

LEVEL/FREQUENCY

TRANSMITTER

Frequency Range:	20 Hz to 5000 Hz
Resolution:	1 Hz
Accuracy:	+/- 0.5 Hz
Output Steps:	1 Hz, 10 Hz, 100 Hz, or 1000 Hz steps may be selected.
Level Range:	- 60 dBm to + 12 dBm
Resolution:	0.1 dB
Accuracy:	+/- 0.1 dB @ 1004 Hz (0 to -19 dBm), +/- 0.2 dB at all other frequencies.
Flatness:	+/- 0.2 dB (200 Hz to 5 KHz referenced to level at 1KHz)
Distortion:	- 60 dB @ 1004 Hz, 0 dBm

RECEIVER

Frequency Range:	20 Hz to 5000 Hz
Resolution:	1 Hz
Accuracy:	+/- 1.0 Hz
Level Range:	- 60 dBm to + 12 dBm
Resolution:	0.1 dB
Accuracy:	+/- 0.1 dB @ 1004 Hz (0 to -19 dBm), +/- 0.2 dB @ 200 Hz to 5 Khz

NOISE MEASUREMENTS

Input:	Balanced or Noise to Ground
Weighting Filters:	C-MSG, C-NOTCH, 3 KHz Flat
Notch Filter:	1010 Hz (995 Hz to 1025 Hz Notch); > 50 dB Notch depth
Range:	0 dBrn to 100 dBrn (Balanced) 50 dBrn to 100 dBrn (Noise to Ground)
Resolution:	1.0 dB
Accuracy:	+/- 1.0 dB

TABLE 1-1 *Specifications(con't)*

RETURN LOSS MEASUREMENT

Modes:	ERL, SRL-LO, SRL-HI or OSC
Transmitted Signal:	Meets the specifications of Bell Publication 41009 (Tables D, E and F, page 13) and IEEE Standard P743

2-WIRE RETURN LOSS

Transmitter Level:	-10 dB relative to TLP
Receiver Range:	0 dB to 40 dB
Resolution:	1.0 dB
Accuracy:	+/- 0.5 dB
Internal Hybrid Impedance:	600 or 900 ohms +/- 0.1% in series with 2.16 uF +/- 1%

4-WIRE RETURN LOSS

Impedance:	150, 600, 900, or 1200 ohms
Transhybrid Loss Compensation:	- 30 dB to + 30 dB
Transmitter Level:	- 10 dB relative to TLP
Receiver Range:	0 dB to 50 dB
Resolution:	1.0 dB
Accuracy:	+/- 0.5 dB

TABLE 1-1 *Specifications (con't)*

SUPERVISORY SIGNALING

WINK TIMING

Resolution:	5 msecs.
Accuracy:	+/- 5 msecs.
Wink Fail Event:	Fails for wink period >600msecs.
Off-Hook Fail Event:	Fails for Off-Hook period <200 msecs.

E/M SUPERVISION

Types:	I, II, III, IV, V
Battery:	- 48 VDC current limited to 50 mA

Threshold Voltages:

	E Lead	M Lead
On Hook	< - 16 V	> - 16 V
Off Hook	> - 16 V	< - 16 V

LOOP SUPERVISION

Types:	2 and 4 Wire Loop Start, Ground Start, Loop Reverse Battery, and SX supervision.
Battery:	- 48 VDC series limited to 120 mA

MF AND DTMF SENDER

Frequency Accuracy:	+/- 0.1% of Bell Standard Frequencies
Adjustment Range:	Tone Frequencies adjustable in 0.1% steps to +/- 10% of standard Bell frequencies for Margin Testing
Level:	Automatically adjusted to - 7 dB per tone relative to TLP
Level Adjustment Range:	Tone level adjustable in 0.1 dB steps from - 60.0 dBm to + 6.0 dBm.

TABLE 1-1 ***Specifications (con't)***

Resolution:	0.1 dB
Accuracy:	+/- 0.2 dB
Timing:	MF: 70 mS Tone On and Tone Off (KP is 100 mS Tone On) DTMF: 50 mS Tone On and Tone Off
Timing Adjustment Range:	Tone On and Tone Off times adjustable in 1 mS steps from 25 mS to 999 mS
Resolution:	1 mS
Accuracy:	+/- 1.0 mS

DIAL PULSE SENDER

PPS

Range:	5 to 25 PPS
Resolution:	0.1 PPS
Accuracy:	+/- 1.0%

% BREAK

Range:	10 to 90%
Resolution:	0.1%
Accuracy:	+/- 1.0% for 25% to 75% BRK @ 10PPS

INTERDIGIT TIMING

Range:	260 to 999 mS
Resolution:	1 mS
Accuracy:	+/- 1.0 mS

TABLE 1-1 ***Specifications (con't)***

GENERAL

Impedances:	150, 600, 900, 1200 ohms and > 50 Kohms Bridging
Maximum DC Blocking:	160 VDC
Audio Bandwidth:	+/- 3.0 dB 300 Hz to 3.0 KHz
Audio Volume:	Adjustable by front panel control
Longitudinal Balance:	80 dB at 60 Hz
Receiver Return Loss:	> 30 dB 200 Hz to 5 KHz (600, 900, 1200 ohms)
	> 30 dB 800 Hz to 5 KHz (150 ohms)
Display:	40 character vacuum fluorescent plus 4 LED's for ON/OFF Hook status
AC Power Supply:	115 VAC +/- 10%, 60 Hz
Operating Temperature:	0 C to 50 C
Storage Temperature:	- 40 C to 70 C
Dimensions:	5.79" H. x 14.33" W. x 14.25" D.
Weight:	17 lbs.

DS-1 DROP/INSERT MODULE OPTIONS (OPTIONS 8 AND 9)

Format:	DS-1 AMI Line Code
Input Frequency:	1.544 Mbps +/- 50 ppm (DSX std)
Channel Numbering Sequence:	D1D, D2, D3/D4
Signaling Mode:	NORM (Robbed Bit), CCIS
Input Mode:	Terminated: 100 ohms nominal Bridging: >1000 ohms
Input Level:	200 mV to 6.0 V base to peak
Channel Selection:	Any one of 24 selectable from keypad
PCM Supervision Displays:	40 character vacuum fluorescent display shows A&B bit signaling states for all 24 channels (Menu option #20) simultaneously. 4 LED's show status of ON/OFF Hook supervision of selected time slot.

TABLE 1-1 ***Specifications (con't)***

Operating Modes:	TX/RX, THRU, Dual Direction Drop/ Insert (Opt. 9) with front panel selection of transmission direction.
Pattern Simulation:	Idle Code (All Ones) Received PCM (THRU Mode)

PCM CHANNEL SIMULATION SOURCES

Analog Tones:	20 Hz to 3900 Hz selectable in 1.0 Hz steps from keypad
Tone Level:	+ 3 dBm to - 50 dBm in 0.1 dB steps selectable from keypad
Supervision:	A and B bits (0 and 1 states user defineable)
Signaling:	MF, DTMF, and DP
DS-1 Output Level:	3.0 V nominal base to peak into 100 ohms resistive load

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SECTION II
INSTALLATION

2-1 INTRODUCTION

This section provides information regarding initial inspection and damage claims, preparation for operation, power requirements, storage and shipment. Also provided is a physical description of the Model 930A.

2-2 INITIAL INSPECTION

When the instrument arrives inspect the shippng container for visible signs of stress or damage. If the shipping container or packaging material is damaged notify the carrier as well as SAGE immediately. Retain the materials until the contents have been checked mechanically and electrically. The contents of the shipment should be one Model 930A, one copy of the Operating Manual, and one AC power cord. Accessories may or may not be shipped in the same container as the Model 930A depending upon their size. Check the shipping invoice carefully against the contents received.

2-3 PREPARATION FOR USE

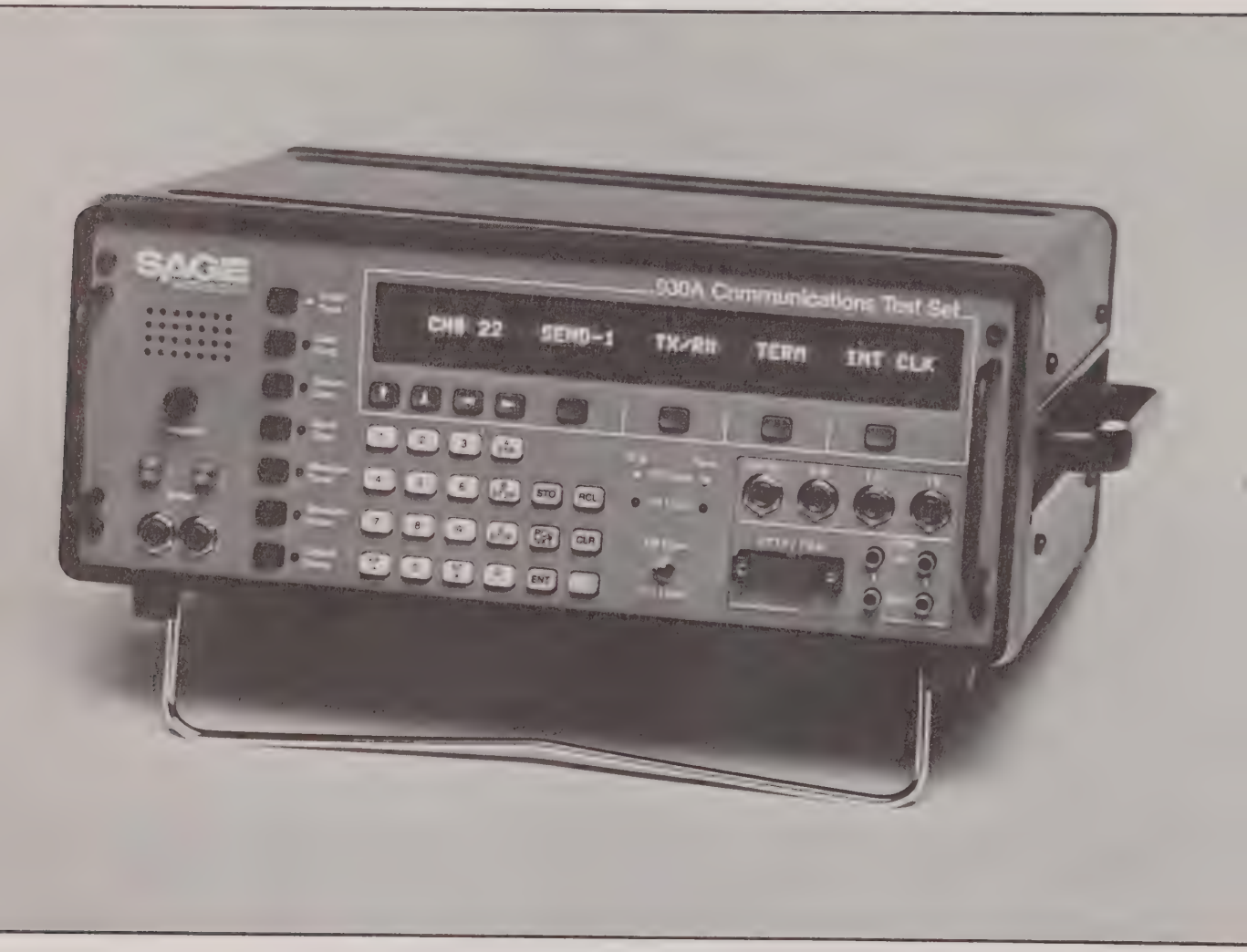
CAUTION

This instrument is designed to operate on 115 VAC, 60 Hz power. Connection to a power source other than this will cause damage to the Model 930A. Consult the factory for optional power sources.

Connect the Model 930A to any standard three conductor outlet of 115 VAC, 60 Hz using the power cord supplied with the unit. The three wire power cord supplied with the unit grounds the instrument.

WARNING

Do not interrupt the protective (ground) conductor (inside or outside the instrument) or disconnect the protective earth terminal as this can make the instrument an electrical shock hazard.



SAGE INSTRUMENTS MODEL 930A

FIGURE 2-1

2-4 OPERATING ENVIRONMENT

This instrument may be operated in temperatures from 0 degrees C to 50 degrees C (+ 32 degrees F to + 122 degrees F). The instrument will operate in environments with humidity from 10 to 90% relative humidity non-condensing, at +40 degrees C (104 degrees F).

2-5 STORAGE AND SHIPMENT

The instrument may be stored and shipped within the following environmental limits:

* Temperature -40 to +70 degrees C
* Humidity Up to 90% Relative @ +65 degrees C

Shipment of the instrument for return to SAGE is facilitated by retaining the original shipping container and packing materials. In the event that the original container is no longer available the following general instructions should be used for repackaging the instrument with commercially available materials.

1. Include return address, serial number, and name of technical contact when returning instrument for service.
2. Use a double-walled carton made of at least 350 pound test material and of a size which permits space for shock-absorbing material.
3. Use a 3-4 inch layer of shock absorbing material on all sides top and bottom of the instrument. Protect the front panel with cardboard.
4. Seal the container securely.
5. Mark the container FRAGILE to ensure careful handling.
6. Refer to the instrument model number and serial number in any correspondence.

MODEL 930A FRONT PANEL

FIGURE 2-2

2-6 PHYSICAL DESCRIPTION

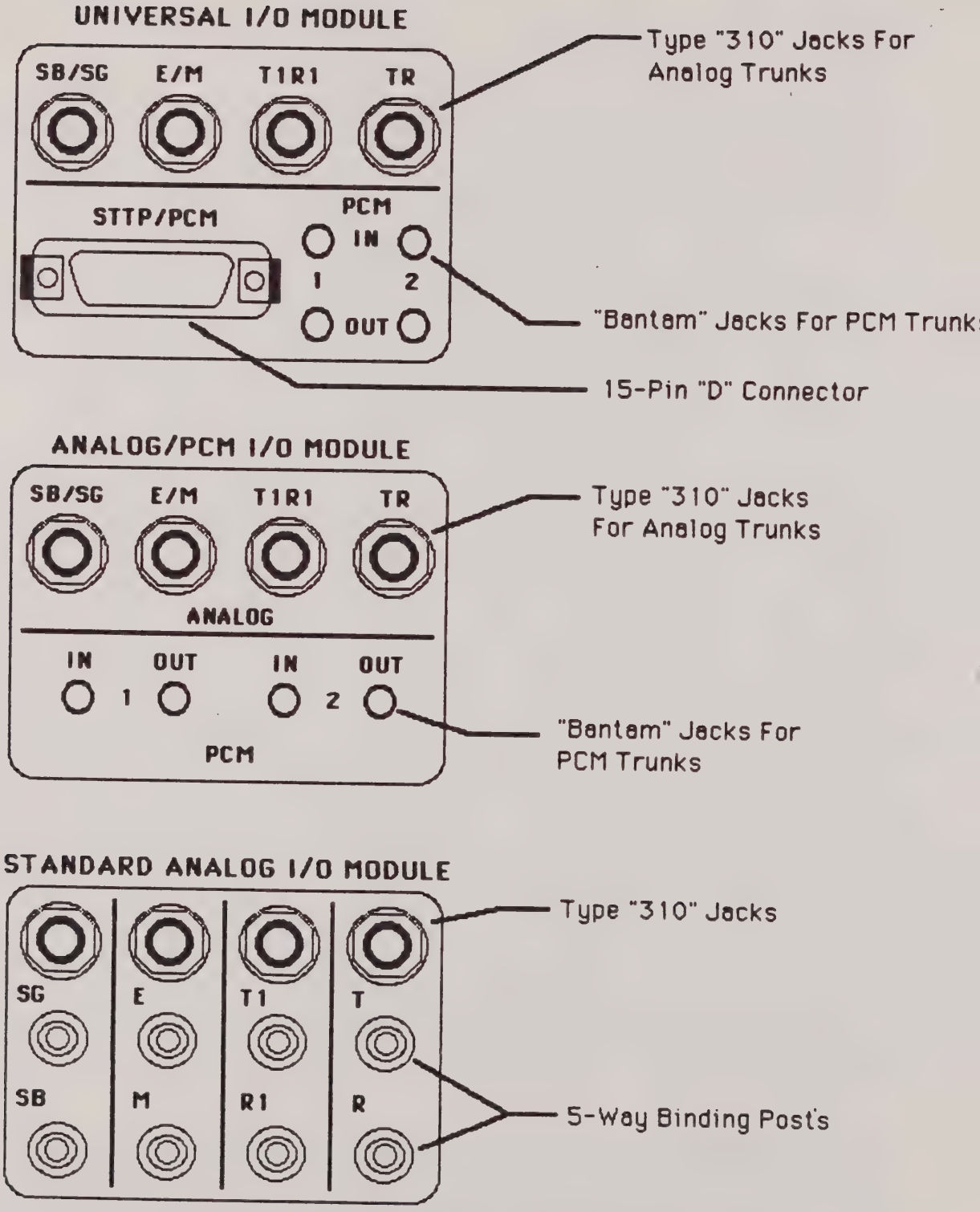
The SAGE Instruments Model 930A shown in Figure 2-1 measures 5.79" H. x 14.33" W. x 14.25" D. A convenient carrying handle extends 1.25" from the right side of the instrument case. Two smaller carrying handles extend 1.25" from the front panel of the Model 930A. Four rubber feet extend 0.5" from the left side of the case. Four large plastic feet extend 1" from the rear panel of the unit permitting the operator to set the unit on end when performing tests at the DSX jackfield. The unit normally sits on the four plastic feet which extend 0.5" from the bottom of the case. For ease of viewing by the operator the Model 930A is equipped with a pivot brace inside the front feet which raises the front of the unit three inches when extended.

The front panel shown in Figure 2-2 measures 5.25" H. x 13.5" W. It contains 37 keys, 11 LED's, a speaker grill, a volume control knob, two carrying handles, a hook switch, a 2.25" x 3.25" configurator panel which contains the input/output connectors, a 40 character alphanumeric Fluorescent Indicator Panel, and a connector for a headset and butt-in.

The configurator panel is located in the lower right side of the front panel as shown in Figure 2-2. Depending upon which configurator has been ordered, it will contain some combination of 310 jacks, bantam jacks, 5-way binding posts, or a 15 pin subminiature D type connector. Various configurators are shown in Figure 2-3.

The "A" configurator panel is used in those units which are intended for use in an entirely analog environment and which have no PCM module options. The 310 jacks are for the analog input/output and are labeled SB/SG (Signal Battery/Signal Ground), E/M (The E and M leads), T/R (Tip and Ring), and T1/R1 (Tip-1 and Ring-1). The E/M and SG/SB leads are used for E&M signaling. TR and T1R1 are used by all 4-wire analog trunks. All 2-wire signaling and transmission is done over TR. The binding posts are below their corresponding 310 jacks and are labeled SG, SB, E, M, T, R, T1, and R1.

The "A/P" configurator is intended for use in those units which have both analog and digital (DS-1 PCM) capability. That is, option 8 or 9 has been installed. The bantam or tiny telephone jacks provide digital access for the PCM trunks. They are labeled PCM1 IN, PCM1 OUT, PCM2 IN, and PCM2 OUT.



CONFIGURATOR PANELS

FIGURE 2-3

The "UNIV" configurator is intended for use with analog/digital trunks and also has a 15 pin subminiature D type connector for use with the SAGE Model 114A Supplementary Trunk Test Panel Adapter. This would mean that option 14 has been installed.

The rear panel shown in Figure 2-4 measures 5" x 13.5" and contains the following:

ON/OFF Switch
Receesed connector for three-prong power cord
Fuse Holder
Fan Grill
Grounding Lug
25 pin RS-232C "D" type connector (optional)
Four plastic feet with soft rubber tips

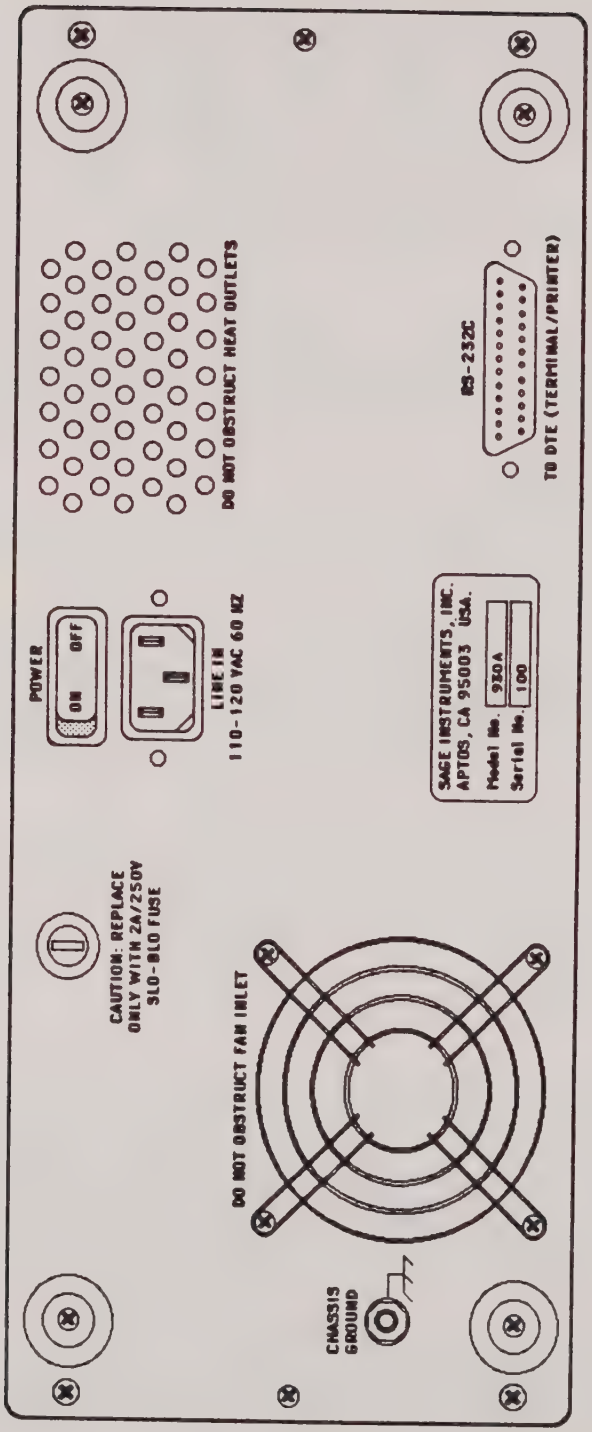
The ON/OFF switch controls power to the 930A. It is located at the top center of the rear panel as shown in Figure 2-4. The AC power connection is located directly beneath the ON/OFF switch and is intended for use only with the power cord supplied with the unit.

The fuse holder is spring loaded and access to the fuse is by inserting a flat blade screwdriver into the fuse holder slot and making a 1/4 turn counterclockwise. The fuse is a 2 Amp Slow-Blow. If a power surge causes the fuse to fail, be sure to replace it ONLY with a fuse of the same rating, and ONLY after determining that the condition which caused the failure no longer exists.

The fan grill allows access for cooling air into the Model 930A. Do not block the air intake, place it adjacent to a heating duct, or operate the unit standing on it's rear panel on a thick carpet. Holes drilled in the upper right side of the rear panel are intended for the exit of warm air. These should not be blocked either or damage to the Model 930A may result.

The rear panel plastic feet support the 930A on a level surface for operator convenience. DO NOT place an operating 930A on thick carpets or on surfaces that are thick with dust as access to the fan grill may be blocked.

The grounding lug, located at the lower left edge of the rear panel, provides ready access to the Model 930A's case ground for safety purposes.



MODEL 930A REAR PANEL

FIGURE 2-4

The RS-232C connector (Option 10) when present, is located at the lower right side of the rear panel. The connector is configured internally as Data Communication Equipment (DCE). This enables direct connection to Data Terminal Equipment (DTE) such as terminals or printers. However, connection to a MODEM (DCE) must be made through a "null modem" adapter cable.

CAUTION

The rear panel is held in place by four screws.
DO NOT REMOVE THEM
Access to the interior of the Model 930A is
provided by removing the top cover.

The top cover of the 930A case is secured by four 3/8 inch Phillips head screws. Removing these screws allows the cover to be lifted off, giving access to the interior. Figure 2-5 shows the interior of the Model 930A.

At the rear of the interior is a gold anodized box which contains the power supply.

WARNING

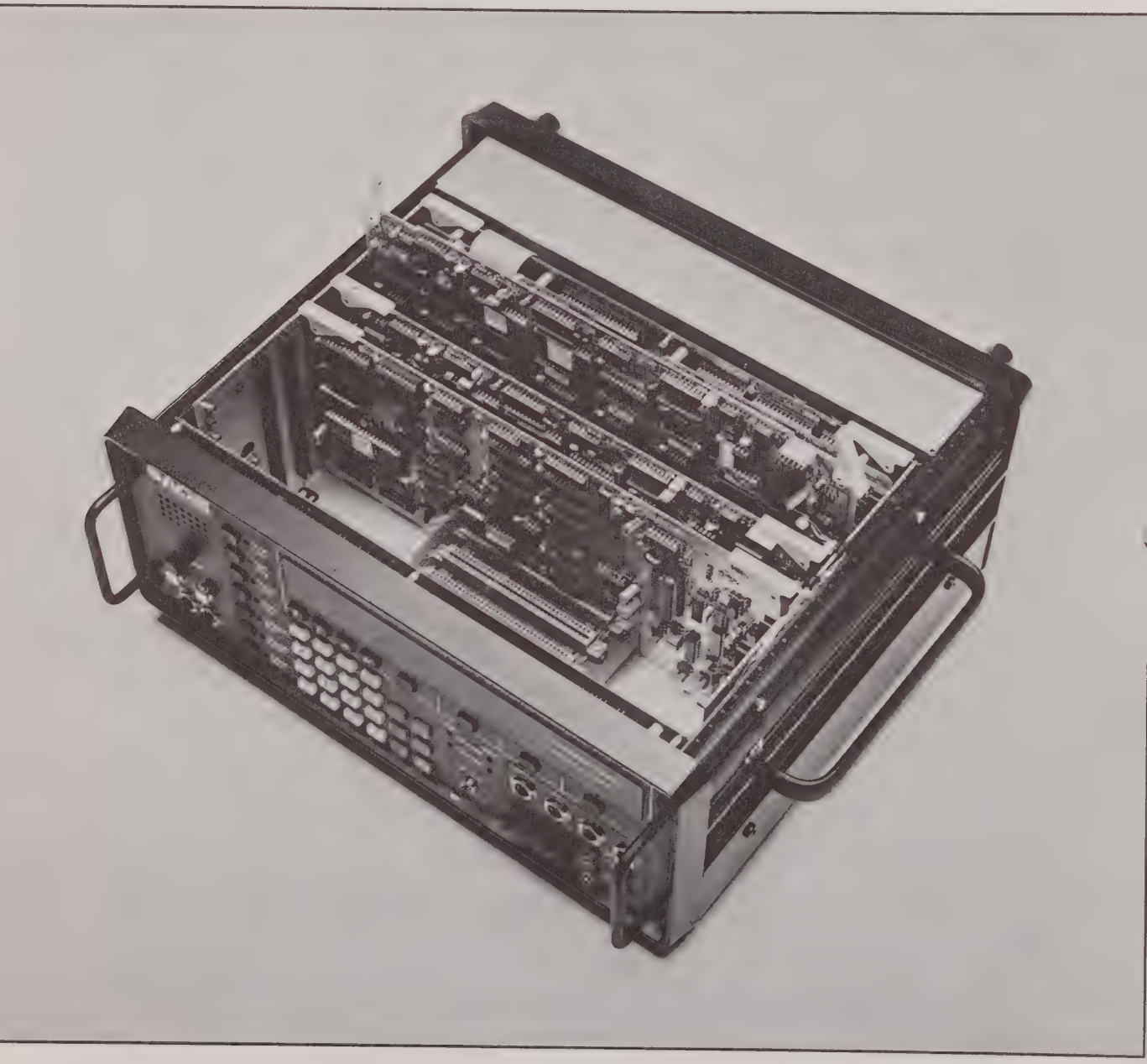
DO NOT ATTEMPT TO OPEN OR REMOVE THIS BOX
Doing so will expose the user to dangerous voltages.

The power supply is a 115 VAC line switching supply. It is intended for connection to standard U.S. line outlets and provides -48 V., +/- 15 V., and +5 V. internally.

There are seven PC Card slots inside the case. Some or all of these will be filled with cards depending upon options installed. The common cards for all units include a CPU card, at least one Digital Signal Processing (DSP) card, an AC interface, and a DC interface card. Other card slots are for options such as one or more PCM cards.

WARNING

DO NOT REMOVE OR INSERT CARDS WHILE POWER IS ON



MODEL 930A INTERIOR VIEW

FIGURE 2-5

The user may have occasion to remove a card from the Model 930A. Remove any attached cables from a card before attempting to remove the card.

Cards are removed by means of the extractors built into each card. The small white plastic handles in each corner of the cards are the extractors. To remove a card, grasp the extractor handles and pull straight upward in an even motion.

When reinserting cards, they should enter their slots with an audible and tactile snap. Be sure that the cards are returned to their correct slot and that all connecting cables to the cards have been correctly restored before applying power. Partially inserted boards will be damaged if power is applied.

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SECTION III
OPERATION

3-1 INTRODUCTION

This section of the manual provides the user with information on operation of the Model 930A to test in analog and digital communications networks. The Model 930A is a general purpose test set which has been designed to test Equal Access (Feature Groups A-D), DS-1, PBX, Data, Toll, and Private Line trunks. The Model 930A is particularly well suited to testing at the local DEMARC.

3-2 OPERATING CHARACTERISTICS

The Model 930A performs the three basic functions required of a DEMARC test set in today's environment. These are: Transmission Measurements, Signaling and Supervision, and DS-1 PCM Drop/Insert (optional) testing.

The Model 930A has been designed to access and perform tests on the following types of circuits:

Equal Access (Feature Groups A-D)
Centralized Automatic Message Accounting (CAMA)
Traffic Service Position System (TSPS)
Toll
International Direct Distance Dialing (IDDD)
Data
PBX
Private Line Automatic Ringdown (PLAR)
Manual Ringdown (MRD)
Foreign Exchange Office and Station ends (FXO/FXS) (optional)
DS-1 PCM TX/RX (Half-Channel) (optional)
DS-1 PCM Dual Direction Drop/Insert (optional)
Automatic Identified Outward Dial (AIOD) (optional)

The Model 930A can simulate the telephone company central office as well as the terminating end of the circuit, be it customer provided equipment, an Inter-LATA carrier, or DEMARC or Point of Presence.

The transmission measurements which the 930A can make are:

1. Level and Frequency
2. Noise (C-Message, C-Notch, or 3KHz Flat weighted)
3. Noise to Ground
4. Noise with Tone
5. Return Loss (2-Wire and 4-Wire)
6. P/AR (optional)
7. 3-Level Impulse Noise (optional)

Future options will include Phase Jitter, Non-Linear Distortion, and Envelope Delay Distortion measurement capability.

The signaling and supervision simulation capabilities of the Model 930A are:

1. 2 and 4 wire Loop Start (Normal and Reverse)
2. Ground Start (Normal and Reverse)
3. E&M signaling Types I, II, III, IV, and V
4. Wink
5. Multi-Wink
6. Delay Dial
7. SX supervision
8. DP, DTMF, and MF signaling
9. DP, DTMF, and MF receiver/analyzer (optional)
10. DX supervision (optional)
11. SF supervision (optional)
13. FXO/FXS supervision (optional)

In addition to its supervisory signaling simulation capabilities, the Model 930A can establish the talk condition for transmission testing and has the ability to hold circuits for testing.

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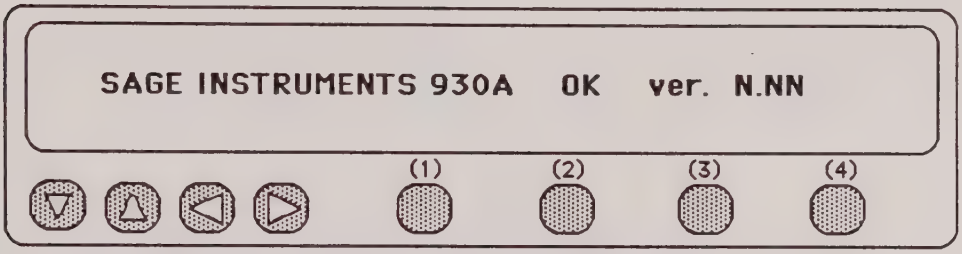
MODEL 930A FRONT PANEL

FIGURE 3-1

3-3 INITIAL TURN-ON PROCEDURE

After reading Section 2-3 of this manual the operator is prepared to turn on the Model 930A. When first switched on, the 930A should display the following:



where "N.NN" is the version of software present in the unit. Note the condition of the eleven LED's on the front panel. If a normal "Warm Boot" has occured then one LED will be lit or flashing. If an error has been detected by the built-in self test, all of the LED's will be lit, and the unit will perform a "Cold Boot". This is an abnormal condition indicating a possible malfunction of the test set.

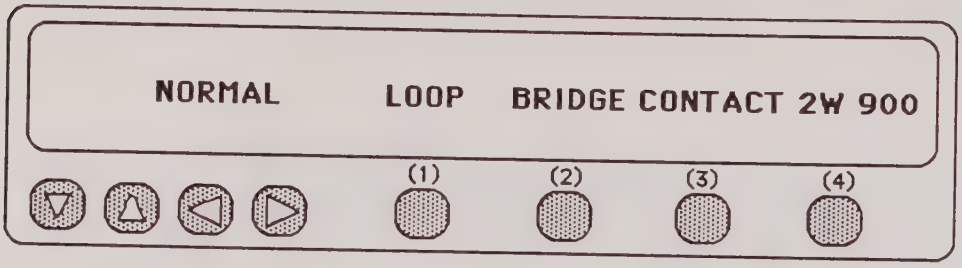
The seven black keys arranged in a column along the left edge of the panel are the Function keys. There is an LED for each key to indicate which function is in use. The Send Tone LED flashes when the 930A is sending tone.

Refer to Figure 3-1 for the locations of the LED indicators and Function keys.

Once the unit has been turned on (regardless of whether a Warm or Cold Boot has occurred) pressing any of the seven Function keys will bring up the Trunk Type display menu. This is the starting point for any testing.

If a Warm Boot has taken place, the display will return to the test state that it was in when the unit was turned off or experienced a momentary power loss . All settings and program storage locations will be exactly as they were since they are stored in battery backed CMOS RAM. The Model 930A will automatically "Boot up" without a key press.

In the event of a Cold Boot, the 930A will reinitialize itself to factory settings. The Trunk Type display will read:



indicating a loop trunk expecting normal Battery/Ground supervision, with the 930A in a bridging mode, ready to supply contact, and a two-wire 900 ohm configuration. Remote control will be off. Storage locations will have been cleared and reset to their factory defaults.

The user may force a Cold Boot if it is desired to return the unit to factory settings. To accomplish this it is necessary to turn the unit off and then switch the unit on WHILE HOLDING DOWN ANY ONE OF THE SEVEN FUNCTION KEYS. Check the LED's (all on) to confirm a Cold Boot. This procedure is not advised unless the user is prepared to accept the loss of any stored test programs since a Cold Boot erases user programs and replaces them with factory defaults.

Under normal circumstances, the Model 930A will power up exactly as it powered down, with all settings and storage locations intact. If power was interrupted while in a Remote Control mode, the unit remains in that mode when power is restored. The Model 930A will continue in the same testing mode it was in prior to the power loss. All commands will be processed normally after power has been restored.

The Model 930A is now ready to use.

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FRONT PANEL LAYOUT

FIGURE 3-2

3-4 FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

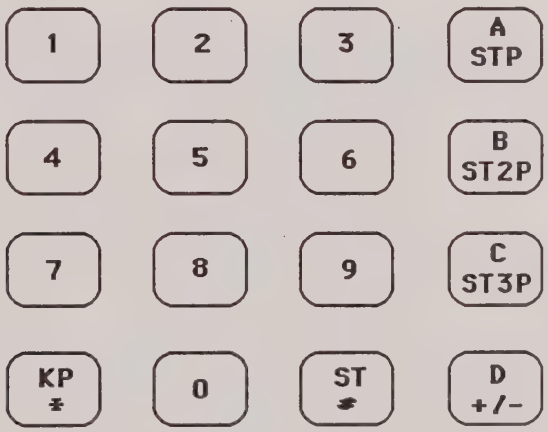
The front panel layout with location of the controls, indicators, and connectors is shown in Figure 3-2.

3-4.1 DATA ENTRY

Data entry on the Model 930A may be acomplished in one of three ways: Numeric entry using the Numeric Keypad; Menu entry using the Soft Keys; or Incremental entry using the Cursor or Arrow Keys.

3-4.2 USING THE NUMERIC KEYPAD

The Numeric Keypad consists of the sixteen white keys located directly beneath the left hand corner of the display as shown in Figure 3-2 and in the diagram below.



When entering numerical data such as Tone Frequency or Level, the user will generally be prompted by a flashing cursor as to the digit location and number of digits expected by the unit. Once the correct numerical values have been selected, data entry is accomplished by pressing either the ENTER key (See Section 3-4.3) or any of the Softkeys (See Section 3-4.4). Any leading blanks (digits expected but not entered) are treated as zeroes.

AS LONG AS THE CURSOR IS DISPLAYED, NUMERICAL INPUT IS EXPECTED. The Model 930A will respond only to numeric data, the +/- (change) key, HELP key, ENTER key, or a Softkey (equivalent of ENTER) in this mode. The following example illustrates use of the Numeric Keypad.

EXAMPLE:

Press the Option Menu key. The most recent Function selection used will be displayed. Press any Numeric Key. A two digit flashing cursor will appear with the number chosen as the least significant digit (pressing ENTER or any Softkey now will enter a one digit number). If a second digit is entered from the numeric key-pad the first digit will be displaced to the left. If the first digit was "1" and the second was "2" then a "12" would be displayed. Keying in more digits will displace those already entered. This allows input to be corrected until ENTER, or any Softkey, is pressed.

The main exception to the previous example is the entry of the strings of digits for outpulsing in the DIAL/RING Function, which will be explained later. In this case no cursor is displayed. The +/- (also labeled "D") key will outpulse the DTMF ("D") tones. Entry may be interrupted or terminated by the user at any time without pressing ENTER.

3-4.3 USING THE SPECIAL FUNCTION KEYS

The six light grey keys located to the right of the Numeric Keypad are the Special Function keys. In many ways the operation of the Model 930A is similar to that of a pocket calculator. This is nowhere more apparent than in the use of the Special Function Keys. The keys and a brief description of their functions follows. More detailed descriptions are contained in sub-sections 3-4.3.1 to 3-4.3.4.

STO - The STORE key is used to store a particular test setup, outpulse sequence, digit string, or any parameters into one of the forty register locations (0 to 39). This is done by pressing the STO key and then entering the two-digit number corresponding to the register location desired. When satisfied that all is correct then press the ENT key.

RCL - The RECALL key is used to recall a test set up or other parameters which have been stored in a particular register. For example, if the user had stored a DTMF sequence in register 28, then to recall the sequence it would be necessary to press RCL, then enter a "2" and an "8" from the numeric keypad and press ENT. Program 28 will then recalled.

RCL NXT - The RECALL NEXT key is a handy way for the operator to sequentially step through a number of stored programs. For example, a user has a sequence of ten tests stored for routining a switch, starting at register location 16. Press "RCL 16 ENT" to begin testing and then press "RCL NXT" to go to Program 17 and so on.

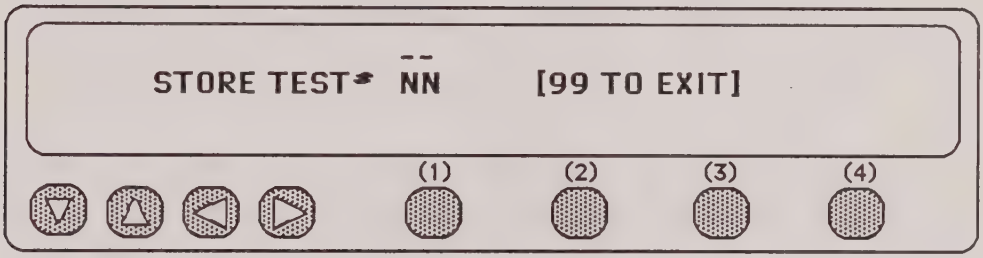
CLR - The CLEAR Key is straightforward in operation. As the name implies, this key will clear the display of any data which has been input. It is NOT a memory clear function. Registers in the Model 930A are erased by simply storing a new program on top of the existing one.

ENT - The ENTER key operates exactly as many calculators function. Once the correct numeric data has been input for a particular test or program, it is necessary to press ENTER.

HELP - The HELP key is provided to assist the user in operating the Model 930A. Any time the user gets stuck, pressing the HELP key provides a series of screens which will generally lead the operator step by step through the function.

3-4.3.1 STORE STO

The 930A has the capability to store up to forty (00-39)test set-ups in battery backed CMOS RAM. Once stored they remain available even after accidental or intentional power losses. The user may change them easily by writing a new program into memory and storing it on top of the old program. Storage is into a numbered location in test memory. The STO key may be pressed at virtually any point in the operation of the Model 930A. The following display will be presented to the operator:



where " NN " is the number of the storage location. If the location number displayed is acceptable, press the ENTER key or any Softkey. If another memory location is desired, simply use the numeric keypad to enter the correct number and then press ENTER or any Softkey. To exit without storing anything simply enter "99" and press ENTER.

All test memory locations are functionally identical so any location can be used. However it is generally a good idea to use consecutive storage locations for related test set-ups. Note that the Model 930A automatically increments the storage location after each entry. The user may make consecutive stores by simply pressing STO and ENT.

Any given storage location may be used any number of times. Storing something new at a location automatically replaces the previous contents. Exactly what gets stored depends upon what the Model 930A is doing when the STO key is pressed. A general description of the stored parameters for various test situations follows:

In Trunk Type: all of the trunk type parameters listed on the display are saved exactly as they are shown. For PCM trunks this includes the undisplayed parameters set in the sub-menu.

In Dial/Ring: the displayed digits, the outpulsing mode (MF, DTMF, or DP), AND ANY MODIFICATIONS made in Modify Send Digits (Function Menu #1) are saved. This includes the absolute level at which digits are sent. The proper level for outpulsed digits changes with trunk type. Digit sequences keyed in and saved under one trunk type may be too loud or too soft if recalled and outpulsed in a different trunk type. If audible distortion or fading of a string being outpulsed occurs, this is probably the cause. Reenter the string and save it with the correct trunk type.

In Return Loss: all of the displayed parameters are saved.

In Send Tone: all of the displayed parameters are saved.

In Measure Tone: all of the displayed parameters, as well as the undisplayed relative zero, are saved.

In Measure Noise: all of the displayed parameters, as well as the undisplayed relative zero, are saved.

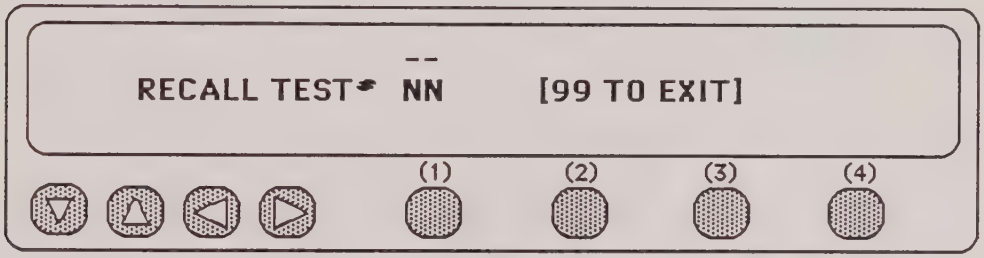
NOTE: In any measurement function, it is the test set-up (parameters) which is saved, NOT THE CURRENT MEASUREMENT RESULTS.

To store a set-up from within a function selection, EXIT TO THE FUNCTION MENU by pressing the Function Menu key. All parameters of the menu selection (whose name and number are displayed) can then be saved using the STO key. The only exception to this is Modify Send Digits (Menu # 1). Parameters set in Modify Send Digits are considered to be undisplayed parameters of the Dial/Ring Function and are saved with Dial/Ring.

It is not possible to use STORE from within a HELP screen or sub-menu nor is it necessary. All parameters set within a sub-menu or HELP screen can be saved with their parent function. Attempts to use STORE when it is not possible will produce no visible effect.

3-4.3.2 RECALL AND RECALL NEXT

Pressing the RCL (RECALL) key will bring up the following display on the Model 930A:



Use the numeric keypad to input the number (between 0 and 39) of the storage location of the desired test set-up. Press ENTER or a Softkey to recall the set-up stored in that location. A "set-up" by definition means one of the Model 930A's functions (or Menu Selections) with its parameters set to their stored values. The Model 930A returns to the function it was in when STORE was pressed and restores the relevant parameters to those which were selected at that time.

Any stored set-up can be recalled by the following sequence; Press RECALL, then select the number of the appropriate storage location (0 to 39), then press ENTER or any Softkey. To exit without recalling a set-up simply input "99" and ENTER.

Pressing the RECALL NEXT key recalls the next consecutive test location without requiring the operator to input a number. This convenient feature enables the operator to rapidly step through a series of related test set-ups with very few key strokes. Using this feature, tests set up by one person can be recalled and run by less skilled personnel, or even a computer, with relative ease. Test sequences for pre-service testing of Digital Channel Banks, Transmultiplexers, Digital Switches, and PBX's are easily stored and can be uniformly performed by any level of personnel. What is recalled will depend upon what was stored. For a description of what is stored when the STO key is pressed, review Section 3-4.3.1.

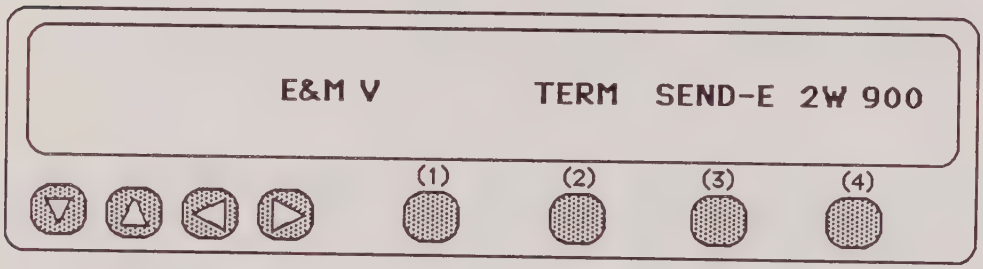
NOTE: If a "Cold Boot" is performed, all storage locations will be cleared. Recalling a blank location brings up the Measure Tone function.

The following simple example will serve to illustrate the use of the STORE, RECALL, and RECALL NEXT keys:

EXAMPLE: One way to measure the loss on a line with the 930A is to perform the following steps:

Press the **Trunk Type** function key.

The 930A display will appear somewhat like:

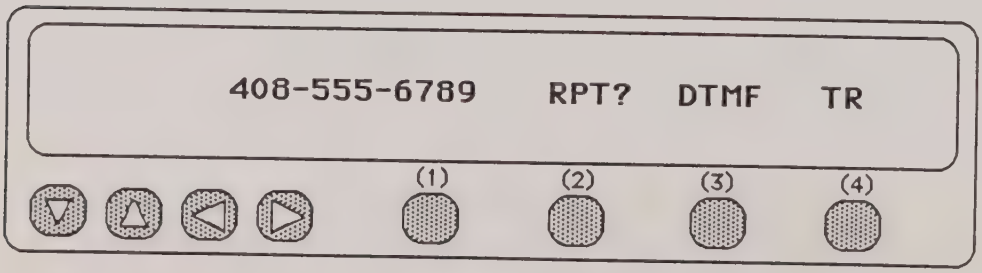


Set up the trunk type to the correct condition (assume that the above displayed trunk type information is correct for this example) and store it in register location 1.

Press the **STO** key, then press **1** and then the **ENT** key.

Next press the **Dial/ Ring** function key.

Go "Off Hook" by placing the Hook Switch in the OFF HOOK position and enter the telephone number of the local milliwatt test line. The 930A wiil dial the number. An example 930A display follows:

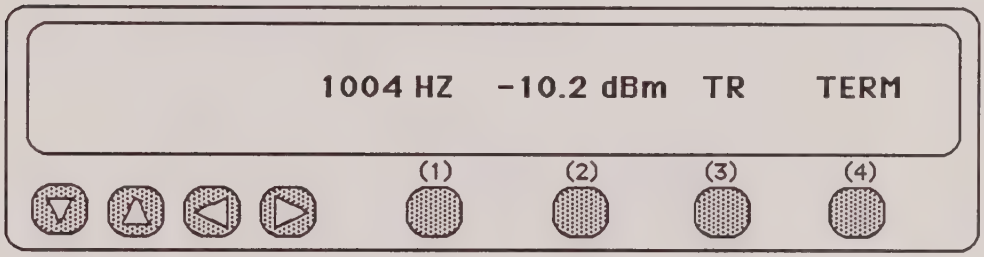


Store the test line phone number in register location 2.

Press the STO key and then the ENT key.

Press the ○ Measure Tone function key.

Measure the level being sent. A typical 930A display is shown below.



Store the Measure Tone Function set up in register location 3.

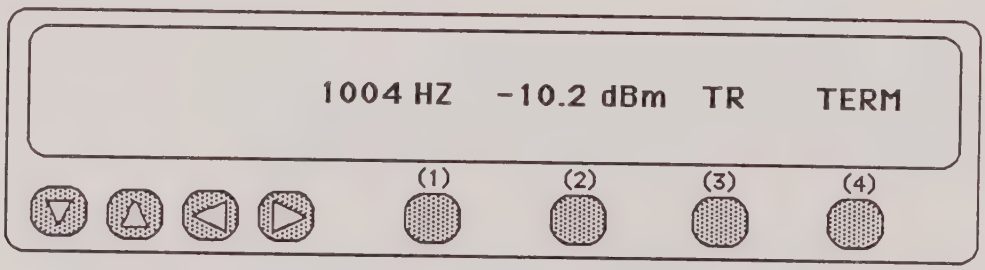
Press the STO key and then the ENT key.

The test has now been performed and the test sequence has also been stored. The entire test can now be rerun at any time with only six simple keystrokes as shown on the next page.

To rerun the test sequence in the previous example follow the steps below.

STEPS	PRESS KEY	DESCRIPTION
1	RCL	
2	1	
3	ENT	Recalls Trunk Type Set-Up
4	RCL NXT	Recalls Milliwatt Number
5	SOFT KEY 2	Places the call
6	RCL NXT	Calls up Measure Tone

The displayed measurement is the loss on the line. A typical display of measured tone would appear somewhat like that shown below:



3-4.3.3 THE HELP KEY

The HELP key is provided to assist the user during operation of the 930A. Any time that the operator encounters difficulty in setting up or using the 930A, pressing the HELP key will provide a series of screens and menu choices. These will take the operator step-by-step through the parameters that need to be selected for the current function. This simplifies set-ups by providing the user with one clearly defined choice at a time until all of the choices have been made.

The HELP screens provide the answers to the most common user questions. For example, if the HELP key is pressed during numeric data input, the user will be prompted to press ENTER to proceed.

3-4.3.4 ENTER AND CLEAR

The ENTER key is used to indicate completion of numeric entry. Any time the value of a parameter is input numerically, it is necessary to press ENTER (or any Softkey) to terminate input and "enter" the number.

The CLEAR key is used to clear or initialize sequences and allow new entries to be made. It is NOT used to clear a numeric value to zero. This is done by simply entering a zero. The CLEAR key is used to clear sequences of variable length, such as a string of digits to be outpulsed.

The only functions which require the use of the CLEAR key, and which are covered in this manual are, Dial/Ring (Section 3-7), Multiple Records (Section 3-12.2), and Receive Records (Section 3-12.4).

3-4.4 USING THE HOOK SWITCH

The chrome switch located to the right of the Special Function keys is the Hook Switch. The four LED's above the Hook Switch are the Supervision Lamps.

A WORD ABOUT SUPERVISION:

The Supervision Lamps are labeled "ORIG" and "TERM". The 930A is obviously the "Originating" end of the circuit when sending digits. The 930A is necessarily the "Terminating" end when receiving digits. In certain applications it is less obvious which end is "Originating" and which is "Terminating". An example of this might be Foreign Exchange circuits. By convention, then, the "ORIG" lamp always shows the 930A's status, unless receiving digits.

The Hook Switch is labeled "ON HOOK" and "OFF HOOK". In order to send a string of digits it is necessary to go "OFF HOOK". This is identical to the procedure employed when placing a regular telephone call. The telephone handset must first be picked up (Going Off Hook) before the number can be dialed. Going "ON HOOK" is the same as hanging up the telephone and terminating the call.

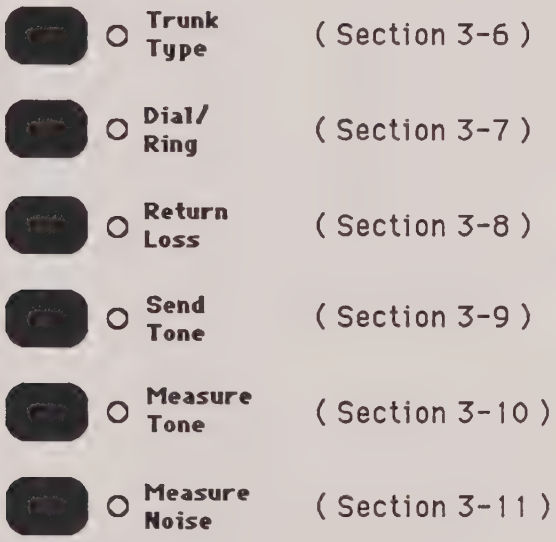
NOTE:

If the Model 930A has been placed in a REMOTE CONTROL mode of operation, the Hook Switch will be inoperative.

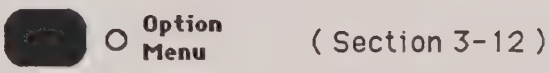
The operation of the Hook Switch on PCM trunks is described in Section 3-14.

3-5 BASIC FUNCTIONS

The six basic functions built into all Model 930A's are controlled by the vertical row of FUNCTION Keys located on the left side of the Model 930A front panel. There are seven Function keys: one for each of the six basic functions and an "Option Menu" key for additional functions and future expansion of capabilities. The six basic functions covered in the following sections are:



Three additional functions are included as standard equipment with the Model 930A.



These functions, accessible under the "Option Menu" key, are: Modify Send Digits, Send Multiple Records, and Wink Timing. These functions are described in Section 3-12.

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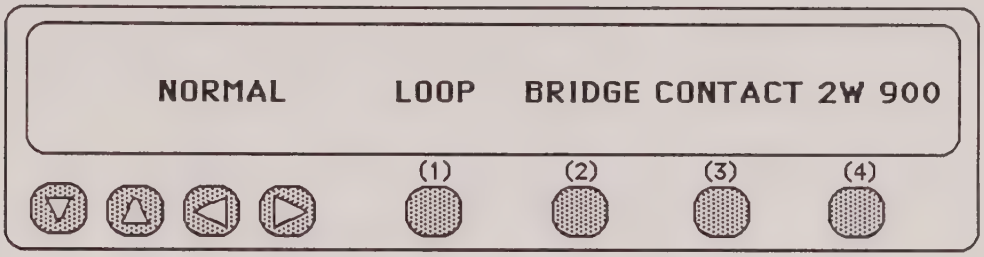
3-6 TRUNK TYPE FUNCTION KEY Trunk Type

Pressing the Trunk Type function key will cause the 930A to display the current trunk type and configuration in use. A typical display is shown below:



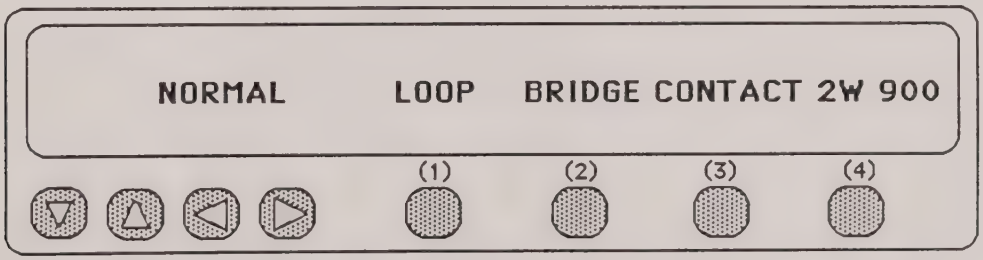
When power is first applied to the 930A it will default to the Trunk Type function after any other Function key is pressed. The appropriate Trunk Type must be selected before any testing can begin.

3-6.1 STANDARD TRUNK TYPES

The basic Model 930A is equipped to operate with Loop Normal, Loop Reverse, Ground Start (Normal and Reverse), and E&M (Types I-V) supervision. The Model 930A can simulate either the Central Office or PBX end of the circuit in TERMINATE mode. The 930A can passively monitor both ends of a circuit in BRIDGE mode.

3-6.2 KEY FUNCTIONS WITH STANDARD TRUNK TYPES

Pressing the TRUNK TYPE function key will produce a display somewhat similar to the example below:



The functions of the various front panel keys when TRUNK TYPE has been selected are as follows:

The Numeric Keypad is inactive

The UP/DOWN arrow keys roll through the available trunk types

The Left/Right arrow keys are inactive

Softkey 1 is a wheel selecting trunk type. It has the same effect as the UP arrow key.

Softkey 2 is a wheel selecting Bridged or Terminated operation. When Terminated the 930A simulates one end of a circuit. In Bridge mode the 930A passively monitors the circuit.

Softkey 3 is a wheel selecting which end of the circuit the 930A simulates in the Terminate mode. In Loop or Ground Start this may be either CONTACT (a telephone or PBX) or BATTERY (Central Office). In E&M this may be either Send-E or Send-M indicating which lead the 930A is using to send supervision.

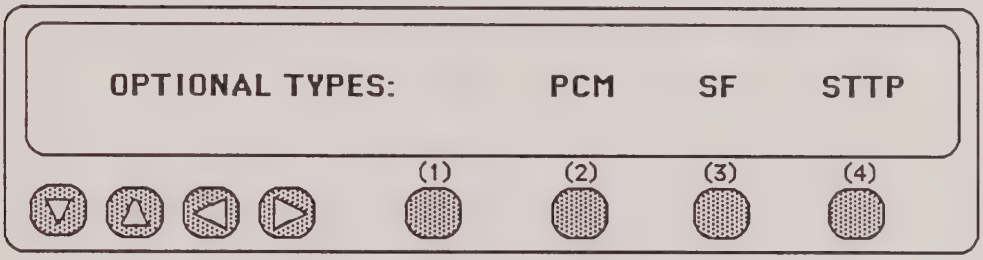
Softkey 4 is a wheel selecting 2 or 4 wire circuits and 150, 600, 900, or 1200 ohm impedances.

NOTE:

Changing trunk types automatically places the 930A in the BRIDGE mode. In the Bridge mode, the 930A does not send supervision. The Supervision Lamp marked "ORIG" shows the end of the circuit which the 930A would simulate if it were in "TERM" mode.

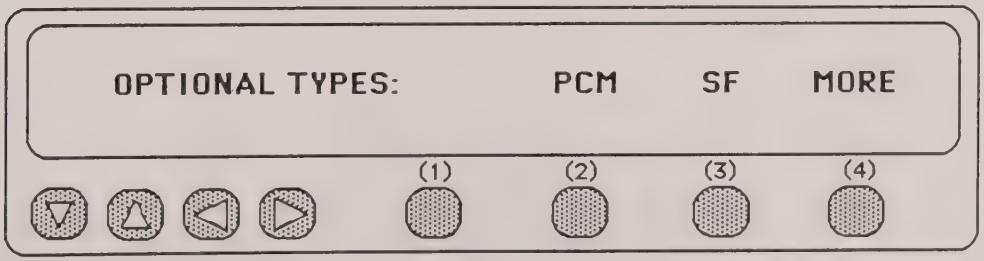
3-6.3 OPTIONAL TRUNK TYPES

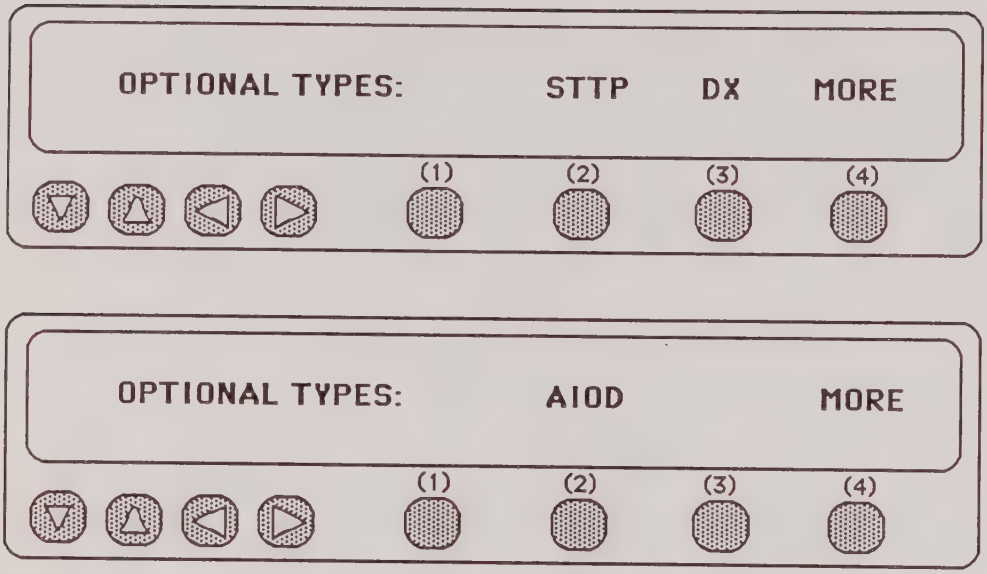
There are several options available for the 930A which expand its capabilities to include testing T-1 (DS-1 PCM) carrier trunks and trunks employing SF supervision. Another option enables the 930A to interface directly with the Supplementary Trunk Test Panel (STTP) used with the No. 1 ESS. Pressing the TRUNK TYPE function key will display the current trunk type. Use the UP/DOWN keys to page through the available trunk types until the Model 930A's display is:



If the options have not been installed in the 930A, attempts to select them will cause the Model 930A to flash a "NOT INSTALLED" message on the display. If any or all of these options have been purchased, then pressing the Softkey located beneath the displayed optional trunk type will cause it to be selected.

Future expansion of optional trunk types to include DX supervision or Automatic Identified Outward Dial (AIOD) trunks is accommodated by changing the format of the optional trunk type screen to one that, in effect consists of three screens. The screens are stacked and accessed by Softkey 4 which is labeled "MORE". That is, the screens have the form:

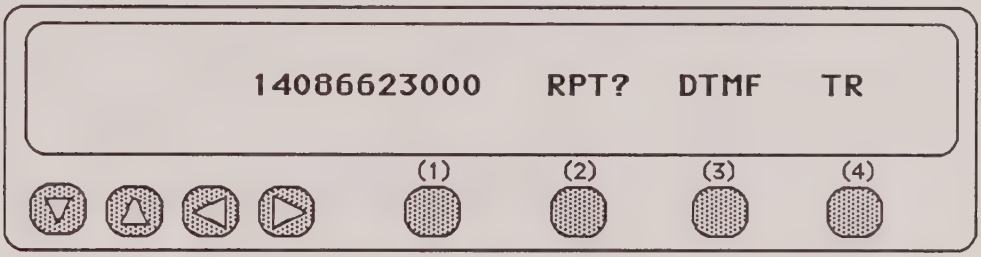




A detailed description of the operation of the optional trunk type functions is contained in Sections 3-14 and 3-15.

3-7 DIAL/RING FUNCTION KEY Dial/ Ring

The Model 930A's front panel controls have been purposely designed for logical operation. After selection of trunk type the next logical step is to have the capability to outpulse the sequence of digits toward the circuit's termination. Pressing the Dial/Ring function key enables the 930A to outpulse digits. If a digit sequence has been previously entered, the 930A display will show it in the first 18 spaces of the display. The 930A remembers the last number dialed. A typical Dial/Ring display for a DTMF (Touch-Tone) digit sequence is shown below:



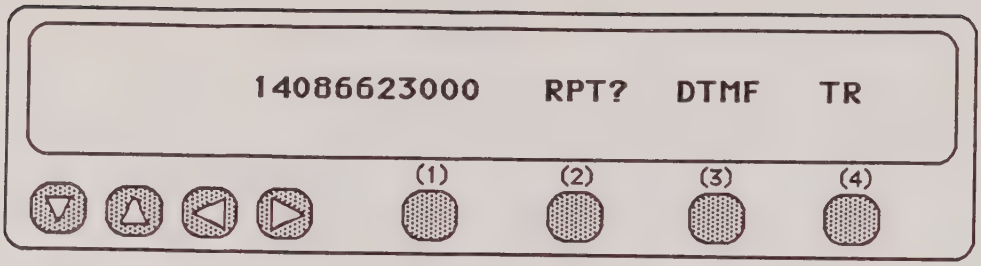
The functions of the various front panel keys when the 930A is in the DIAL/RING mode as shown above are outlined below:

The left arrow key is used to insert a one second pause into a digit sequence and appears on the display as a "-" between digits as in "408-662-3000".

Softkey 1 is inactive.

Softkey 2 is labeled "RPT?" and is asking the question, "Do you want to repeat the previously outpulsed digit sequence?" If the 930A is Off-Hook, pressing this key will outpulse the digit sequence currently displayed.

Softkey 3 is a wheel and is used to select either Dial Pulse (DP), Multifrequency (MF), or Dual-Tone Multifrequency (DTMF). Dial Pulse is not available when the 930A is simulating a CO (Supplying BATTERY). Changing the outpulsing mode will clear the display of any digit sequence.

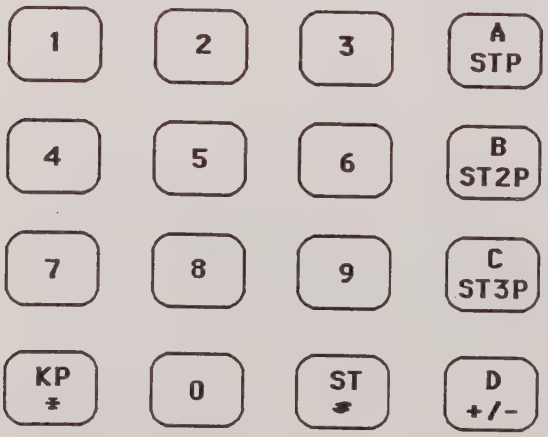


Softkey 4 is inactive. In the display above it indicates which leads are in use for outpulsing (TR, T1R1, Send-E, Send-M, or PCM 1).

The Clear CLR key clears the display and erases any "remebered" digits.

The Enter ENT key is inactive.

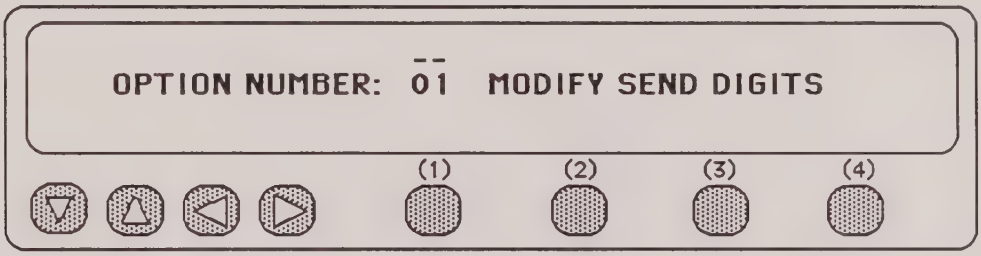
The Numeric Keypad (including the ABCD keys) is the "dialer" and is used to enter digits.



If the Hook Switch is in the OFF HOOK

position, then the digits will be outpulsed as they are entered.

Outpulsing is set to the AT&T standard as the default condition. For example, the MF pulses are 70 milliseconds On and 70 milliseconds Off. The user may modify the level, frequency, and timing of the digits. In order to modify the digits press the OPTION MENU function key. Using the UP or DOWN arrow key as appropriate, scroll through the option menus to Option 1: MODIFY SEND DIGITS. The 930A display should appear as:



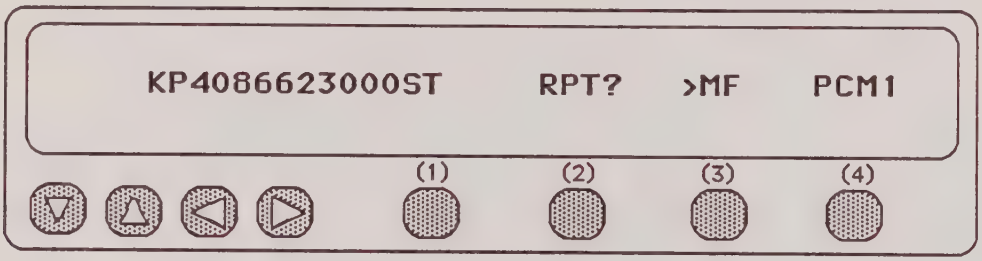
Although labeled as an option, these functions should not be confused with purchased options. The MODIFY SEND DIGITS function is standard on all Model 930A's.

In either MF or DTMF mode the operator can modify the frequency or level of either or both tones, or the timing.

In Dial Pulse, the operator can modify the % Break, Pulses per second, or the Interdigit Timing.

In all cases a Default setting (AT&T Standard) is available.

A feature of the 930A, which is included for operator convenience, is an identifier on the display which tells the user that a parameter has been modified. If any of the parameters have been modified from their default values, a ">" marker precedes the outpulse mode identifier above Softkey 3 during operation. For example, a display of a modified MF sequence might appear as:

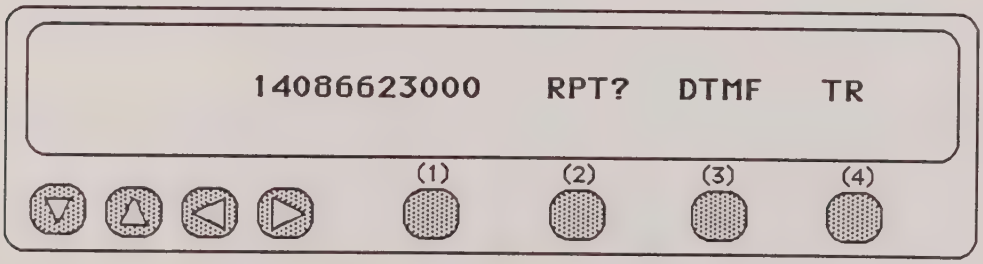


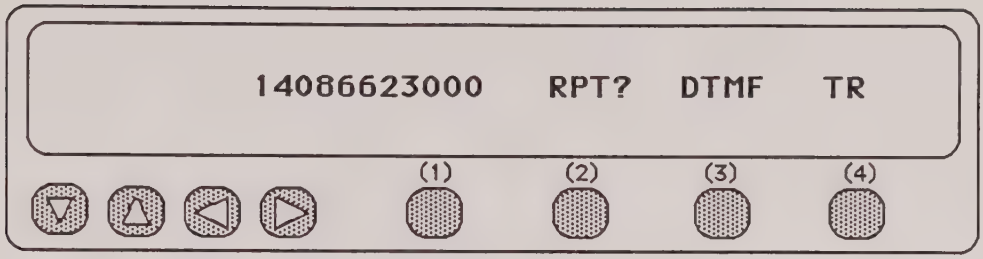
For a detailed description of how to modify the send digits refer to Section 3-12.1.

3-7.1 STORING AND RECALLING DIGIT SEQUENCES

The operator may easily store frequently used digit sequences for future recall and outpulsing. Pressing the STO (Store) key allows the operator to save the currently displayed digit sequence, its outpulsing mode (MF, DTMF, or DP), and any modifications which may have been made using Modify Send Digits (Option Menu 1). The parameters may be stored in any one of the 40 register locations (numbered from 00 to 39).

For example, suppose it is desired to store the unmodifed DTMF sequence, shown in the following display, in register location 17.





To store the DTMF sequence in register location 17, simply perform the following steps:

1. Press the Store [STO] key.

2. Press [1] and then [7]

3. Press the Enter [ENT] key.

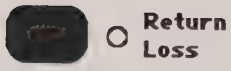
To recall the digit sequence, simply press the Recall [RCL] key, then press [1] and [7] then press the Enter [ENT] key.

A REMINDER

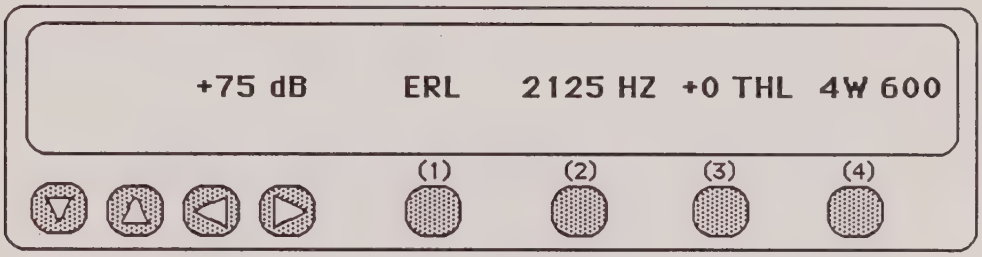
The recalled digit sequence will set the outpulsed parameters to the values that were set when the digits were stored. Always check for the ">" prompt when recalling digits. Any modifications are available for inspection in MODIFY SEND DIGITS (Option Menu 1).

More information on storing and recalling digit sequences with modified parameters is contained in Section 3-12.1. Information on storing and recalling Multiple Record sequences, such as those found in Equal Access, TSPS, and IDDD applications, is contained in Section 3-12.2.

3-8 RETURN LOSS FUNCTION KEY



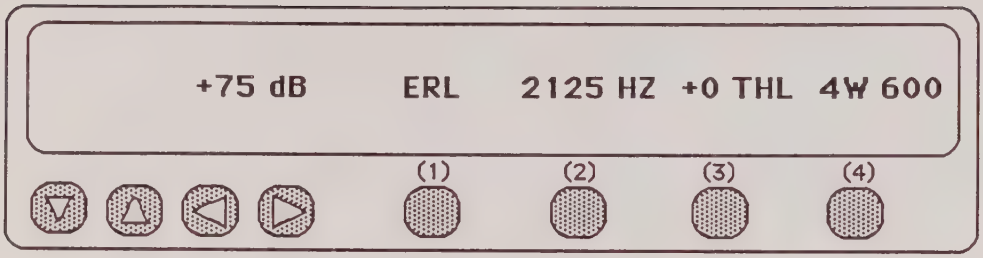
The measurement of Return Loss is an important part of testing a telephone circuit. This measurement function is accessed by pressing the RETURN LOSS Function key which causes the Model 930A to display the last mode of Return Loss measurement which was used. A typical example of a Return Loss display on the Model 930A is:



The Model 930A is capable of Echo Return Loss (ERL), Singing Low (SRL-LO), Singing High (SRL-HI) and Oscillator or Structural (OSC) Return Loss measurements on both 2-wire and 4-wire circuits. Once the RETURN LOSS key has been pressed, the 930A will begin to send the selected Return Loss signal, and receive and display measurements.

The operation of the front panel keys during Return Loss measurement are as follows:

> Softkey 1 is a wheel allowing the user to select the mode of Return Loss (ERL, SRL-LO, SRL-HI, or OSC) , or the type of TR Termination (2 Wire only).

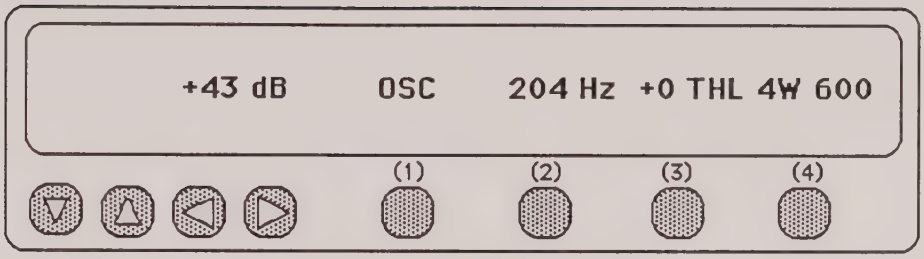


IN ERL, SRL-LO AND SRL-HI:

Softkey 2 sends the echo-suppress tone displayed above it. A common value might be 2125 Hz but the user should verify the correct value. Use the numeric keypad to enter the correct value of echo-suppress tone.

Softkey 3 is inactive in a 2-wire application. In a 4-wire circuit this key selects Trans-Hybrid Loss (THL) as a parameter to be changed. Pressing this key once will cause the current return loss measurement to be interpreted as the THL. By pressing the key again the measurement is locked in and a flashing cursor appears over the THL. At this point the user may enter a specific THL value using the numeric keypad. Otherwise, pressing ENT or Softkey 3 will lock in the displayed value.

Softkey 4 is inactive. The circuit and impedance are displayed above it. These values are set by the Trunk Type function key discussed in Section 3-6.

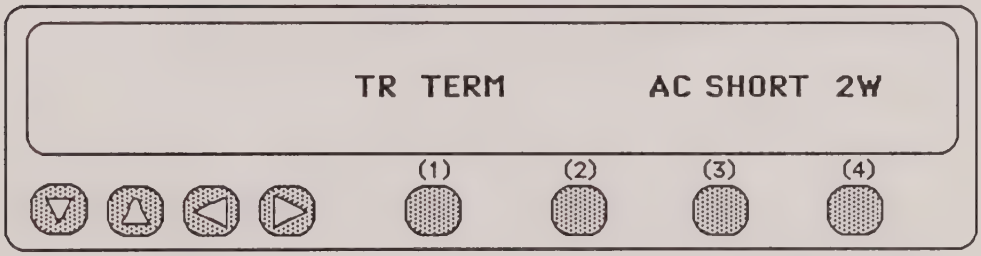


IN OSC (OSCILLATOR OR STRUCTURAL):

Input from the Numeric Keypad modifies the frequency of the tone being sent. Any desired frequency between 20 Hz and 3900 Hz may be entered. The tone is displayed above Softkey 2.

Softkeys 2 and 4 are inactive.

Softkey 3 affects the THL in the same manner as discussed above.



IN TR TERMINATION (2 WIRE CIRCUITS ONLY):

Softkey 2 is inactive.

Softkey 3 is a wheel which enables the user to select the type of termination (AC SHORT, AC OPEN, 600 ohm w/2.16 ufd, or 900 ohm w/ 2.16 ufd).

Softkey 4 is inactive.

NOTE: TR Termination is available only if the 930A is in a 2-wire mode.

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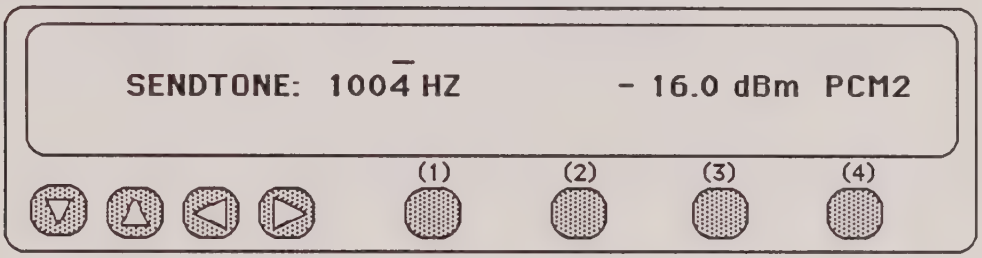
3-9 SEND TONE FUNCTION KEY

The level and frequency of the tones being transmitted by the Model 930A are controlled by this function. Pressing the SEND TONE key will display the current values of the level and frequency being sent. The frequency is adjustable over the 20 Hz to 5 KHz range on Analog trunks and 20 Hz to 3900 Hz on PCM trunks. The level is adjustable from -60.0 dBm to +12.0 dBm on Analog trunks and from -60.0 dBm to +3.0 dBm on PCM.

A typical Send Tone display is provided below for example purposes:



The functions of the front panel keys in the SEND TONE mode are:

Softkey 1 moves the cursor to the least significant digit of the frequency display. Numeric input will be treated as a frequency selection.

Softkey 2 is inactive

Softkey 3 moves the cursor to the least significant digit of the level display. Numeric input will be treated as a level selection.

Softkey 4 toggles between "OFF" and " TR", "T1R1", "PCM1", or "PCM2" depending upon the trunk type and direction. If OFF is selected then no tone is sent and the 930A supplies quiet termination.

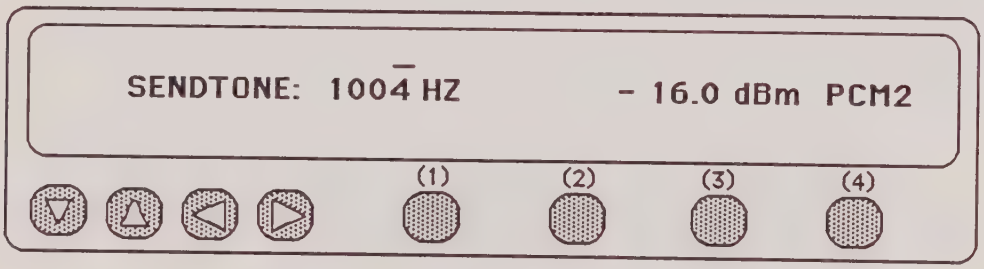
Whenever the Model 930A is operating in a mode other than SEND TONE and a tone is being sent, the LED beside the SEND TONE function key will flash to alert the operator to the fact that tone is being sent. If no tone is desired the operator should return to the SEND TONE function and use

Softkey 4 to place the unit in Quiet Termination by selecting "OFF". The tone selected in SEND TONE is not sent in the DIAL/RING or RETURN LOSS functions.

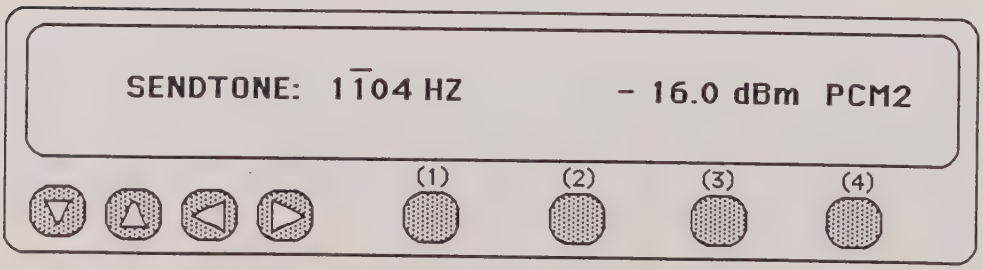
The Left and Right arrow keys position the cursor within a selected field, either frequency or level, from least significant to most significant digit.

The Up and Down arrow keys increment or decrement the frequency or level depending upon the position of the cursor. The step size depends upon the position of the cursor within the field and may be either 1, 10, 100, or 1000 Hz in frequency or 0.1, 1, or 10 dB in level.

The following example of a 930A in the SEND TONE mode should help to clarify this function.



Press Softkey 1 under the frequency display to move the cursor over the least significant digit of the frequency. Press the left arrow key twice to move the cursor over the hundred Hertz column of the frequency display. Pressing the Up or Down arrow key now varies the frequency of the tone in 100 Hz steps. For instance, press the Up key once and the display changes to:



Holding down the Up and Down arrow keys will cause the Model 930A to sweep through the frequency or level steps. By selecting the appropriate frequency step size, for example, the operator can generate a manual frequency sweep. In particular, the operator may desire to sweep from 204 Hz to 3904 Hz in 100 Hz steps. Simply select frequency by pressing Softkey 1. Enter 204 Hz using the numeric keypad. Move the cursor over the hundreds digit using the left arrow key. Check to be sure that the correct level is being sent. Press the Up arrow key to increment the tone from 204 Hz to 304 Hz. Hold the key down to auto-increment the frequency up to 3904 Hz. NOTE: The Model 930A does not go above 3900 Hz in the PCM mode.

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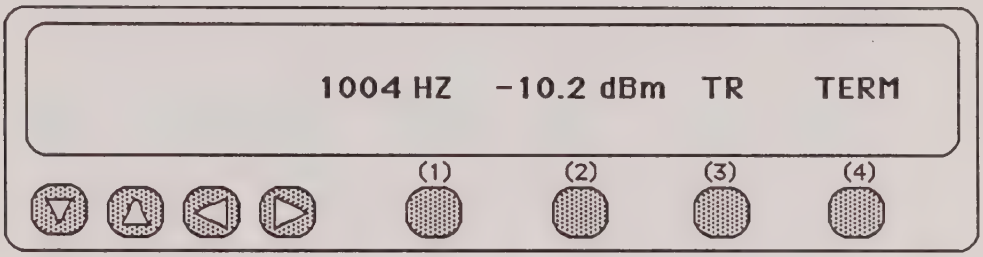
3-10 MEASURE TONE FUNCTION KEY

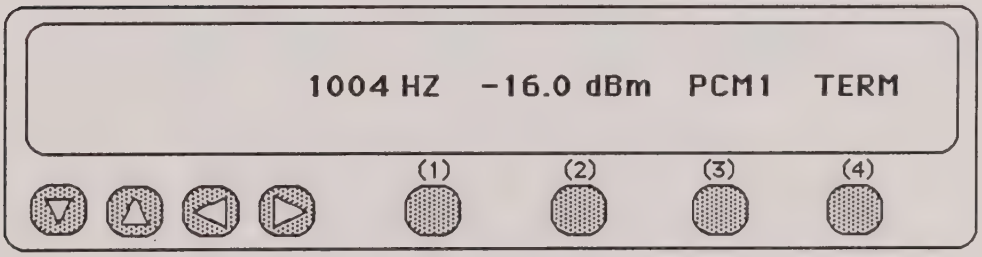
The Model 930A provides the operator with the means to measure and display the level and frequency of received tones. Press the MEASURE TONE function key and the 930A will display the measured level and frequency of any tones present.



The functions of the other front panel keys in the MEASURE TONE mode are as follows:

Softkey 1 is inactive.

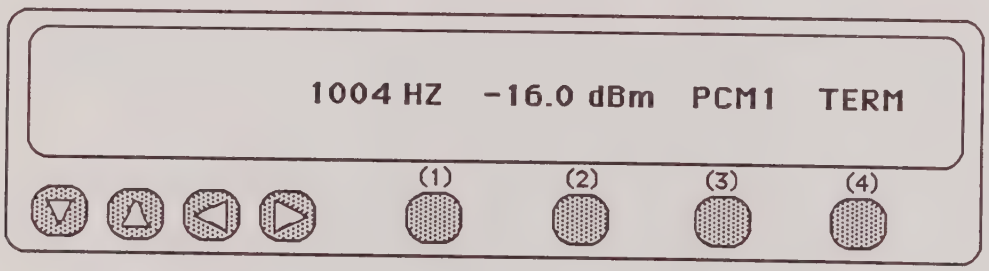
Softkey 3 is inactive. The display above it shows the input from which the measurements are being taken. That is TR, T1R1, PCM1, or PCM2.



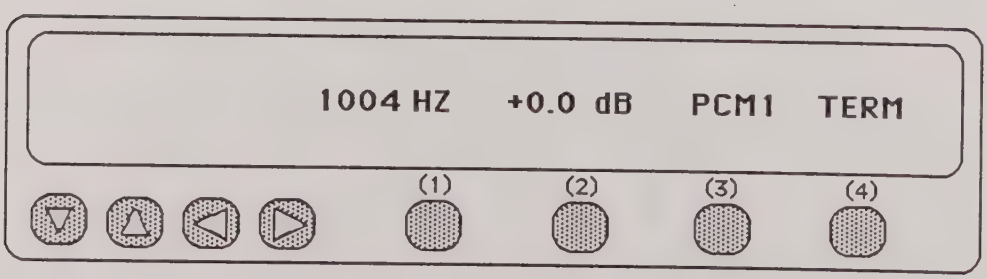
Softkey 4 is inactive. The operating mode, either BRIDGE or TERMINATE, is displayed above this key. These states can only be changed in TRUNK TYPE mode.

Softkey 2 is a wheel which enables the user to select the zero dB level relative to the current measurement. Initially the 930A displays the measurement in dBm. Press Softkey 2 once to lock in the current measured value as the 0 dB reference point. Pressing Softkey 2 again enables the user to input a relative zero numerically (Numeric entry from the front panel keypad must be terminated by pressing ENTER or any Softkey). Once the operator has set the relative zero, another press of Softkey 2 will return the 930A to dBm measurement. For convenience, the 930A displays measurements in dBm (Absolute relative to 1 milliwatt), dB (relative to a measured zero), or dBm0 (relative to a specified zero or transmission level point).

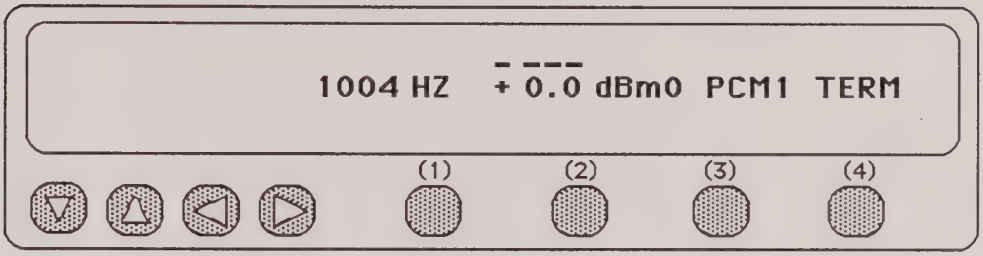
The following illustrations show a typical example of a Measure Tone display as Softkey 2 is pressed starting with the initial dBm measurement:



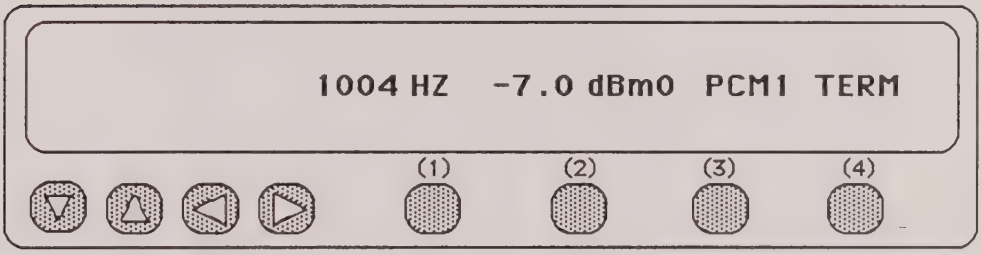
Press Softkey 2 once to lock in the current measured value as the 0 dB reference and the display shows:



Press Softkey 2 again and a flashing cursor appears over the reference level indicating that the 930A expects a numerical value to be input for the TLP as shown:



For example, suppose the TLP at the measurement point is -9.0 dB. Then simply pressing the +/- key, then entering 9 and 0, and pressing the ENTER key will cause the 930A to immediately change the measurement displayed to:



This display shows that a -16.0 dBm signal, referenced to a -9.0 dB TLP, is a -7.0 dBm0 level.

Accurate measurements can only be made if the proper impedance has been selected in TRUNK TYPE mode. In Loop and Ground Start modes, the position of the Hook Switch can affect the AC Termination and therefore the measured level.

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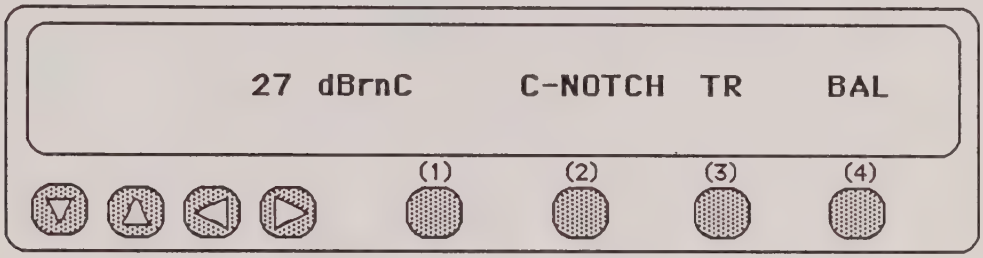
3-11 MEASURE NOISE FUNCTION KEY

Noise measurement using the Model 930A is easily accomplished by pressing the MEASURE NOISE function key. This causes the 930A to display the current measurements, weighting filter types, source, and balance. A typical display might appear as:



The functions of the front panel keys are as follows:

Softkey 1 is a wheel which enables the user to select the measurement units. That is, either dBrn (Absolute), dB (relative to the level being measured when dB was selected), or dBrn0 (relative to a level which is input numerically). Refer back to Section 3-10 and the explanation of MEASURE TONE's Softkey 2 for more details.

Softkey 2 is a wheel which allows the user to select the type of weighting filter desired for a particular measurement. The choices are: C-MESSAGE, C-NOTCH, and 3KHz FLAT.

Softkey 3 is inactive. The input signal source is displayed above it.

Softkey 4 is a wheel which enables the user to select either balanced or Noise-to-Ground measurements on analog trunks. On PCM trunks this window is labeled "CHANNEL" to indicate that the noise being measured is the noise on one channel not the entire 24 channels. On PCM trunks Softkey 4 is inactive.

It is possible to set the relative zero, for measurements in dB, using one weighting filter and then change to another filter. The display will then show the measurement in one filter relative to the other. This feature is particularly useful for measuring notch depth. The following example will serve to illustrate the procedure.

EXAMPLE: Select the C-MESSAGE filter. Press Softkey 1 to set the relative zero equal to the currently displayed measurement. The measurement should now read 0 dB. Press Softkey 2 and select C-NOTCH. The display will now show the notch depth for the tone being measured. For analog trunks the displayed value will be greater than 30 dB. For PCM trunks the number will normally be between 39 and 40 dB.

3-12 OPTION MENU FUNCTION KEY Option Menu

The OPTION MENU function key permits the capabilities of the 930A to be expanded without making the front panel inordinately complex. The front panel of the 930A has been designed so that the most frequently used test functions have their own individual keys. The less frequently used functions, the functions with more complex set-ups, and those functions which are acquired through the purchase of options (PCM testing, SF Supervision, Remote Control, etc.) have been placed under the OPTION MENU key. There are 99 possible menu options for the Model 930A which means that there is plenty of room for growth without rapid obsolescence.

NOTE:

The option numbers for the OPTION MENU functions should not be confused with the order numbers of purchased options.

Pressing the OPTION MENU key causes the 930A to display the most recently selected menu option number and function name. The Up and Down arrow keys allow the user to scroll through the option menu selections. Each menu option displays the number and name of the function if one has been installed. The arrow keys will auto-repeat if held down. Pressing any Softkey will select the option menu currently displayed. Entering a number from the numeric keypad and pressing ENTER will cause the 930A to go directly to that menu option number and enter it. To exit from a menu option at any time, press the OPTION MENU key or any other function key. Some menu options also have a field labeled EXIT and pressing the associated Softkey will cause the 930A to exit that option.

NOTE: To store the parameters which have been set up in a menu option it is necessary to exit from that option. To do this, press the OPTION MENU key, then press the STORE key and give the program a number. The only exception to this is Option 1: Modify Send Digits. This is explained in greater detail in Section 3-12.1.

There are 99 possible menu options for the Model 930A as previously mentioned. In the majority of cases not all menu options will be installed. Some will be reserved for future expansion. These menu options will be labeled "Not Installed" and selecting them will have no effect. There are four menu options included as standard in all Model 930A's. These are:

OPTION 01: MODIFY SEND DIGITS
OPTION 02: MULTIPLE RECORDS
OPTION 09: WINK TIMING
OPTION 15: BEEP ON ERROR

The functions of these menu options and their operation is described in Sections 3-12.1 to 3-12.4. This manual also covers the function and operation of some of the more popular purchased options as they relate to the OPTION MENU. These purchased options and their associated menu options are:

Purchased Opt. 01 (DP,DTMF and MF Receiver/Analyzer) provides the operator with Menu Options 4, 5, 6 and 12 which are the Receive Records group and Wink Margining. These menu options are described in Section 3-13.

Purchased Opt. 08 0r 09 (Single or Dual Direction PCM Channel Access) uses menu option 20 to provide the operator with a display of the A and B signaling bits status on all 24 PCM channels. Menu option 21 allows the operator to toggle the A and B bits independantly and display their status on any selected channel. These menu options are discussed in greater detail in Section 3-14.

Purchased Opt. 10 (Remote Control) uses menu option 3 to provide the operator with the choice of Printer, Terminal, Computer, or Master/Slave modes of operation. Remote control operation of the Model 930A is described in Section 4-1.

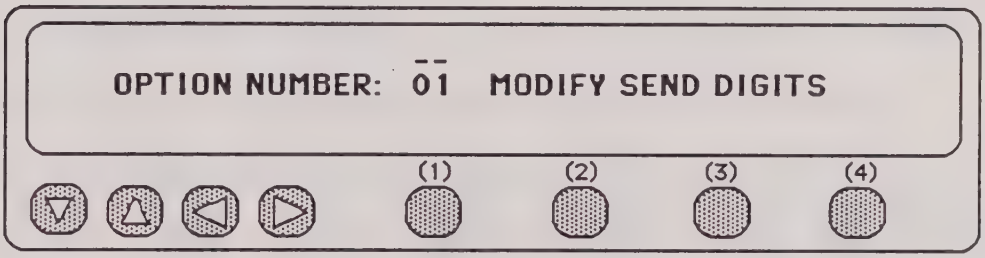
The optional trunk types such as PCM, SF, DX, and STTP/LTTP are not accessed through the menu option but through the TRUNK TYPE function key. These optional trunk types are discussed in Sections 3-14 and 3-15.

3-12.1 MODIFY SEND DIGITS

Menu Option 1, MODIFY SEND DIGITS, is used to modify the parameters of outpulsed digits. This menu option is standard on all Model 930A's and is particularly useful for tolerance testing. That is, testing the ability of far end equipment to recover distorted or non-standard digit transmissions. To begin testing, perform the following steps:

Press the Option Menu **Option Menu** function key.

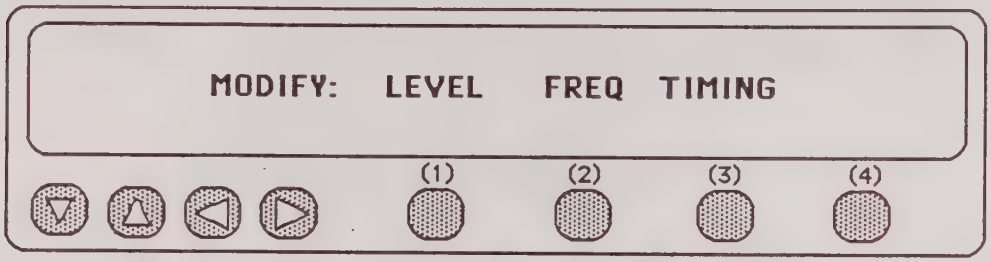
Use the UP/DOWN arrow keys to select Menu Option 1. The Model 930A display will appear as follows:



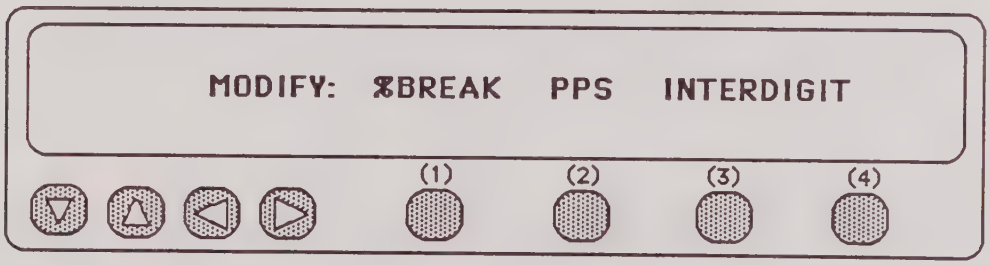
Press any Softkey to enter the function.

NOTE: Entering a numeric 1 and pressing the ENTER key will cause the 930A to go directly to Menu Option 1 and enter it.

Once the operator has entered the function there will be one of two possible displays shown. If the operator has previously selected the MF or DTMF outpulsing mode (refer to Section 3-7) then the display will appear as:



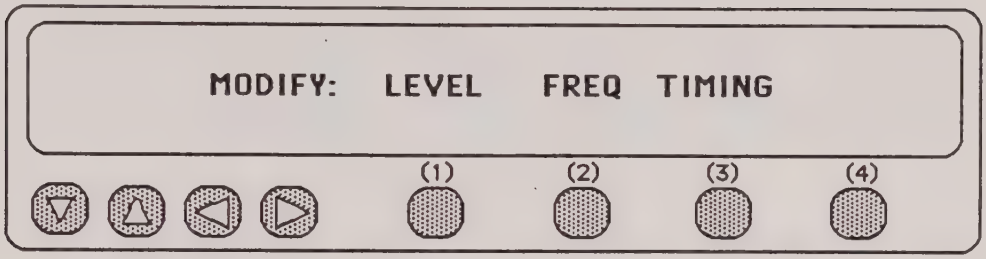
If the operator has previously selected Dial Pulse (DP), then the display will be:



The following sub-sections outline the procedures for modifying the parameters in any of the modes.

3-12.1.1 MF OR DTMF MODE

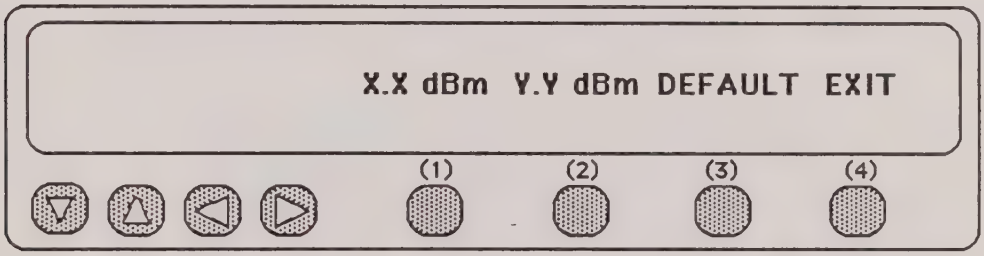
In the MF or DTMF mode the display will appear as:



Use Softkey 1 to inspect or modify the tone levels.
Use Softkey 2 to inspect or modify the tone frequencies.
Use Softkey 3 to inspect or modify the timing.

Press any Function key to exit from this mode and the modifications will be "remembered" by the 930A.

Pressing Softkey 1 (LEVEL) will bring up the following display:

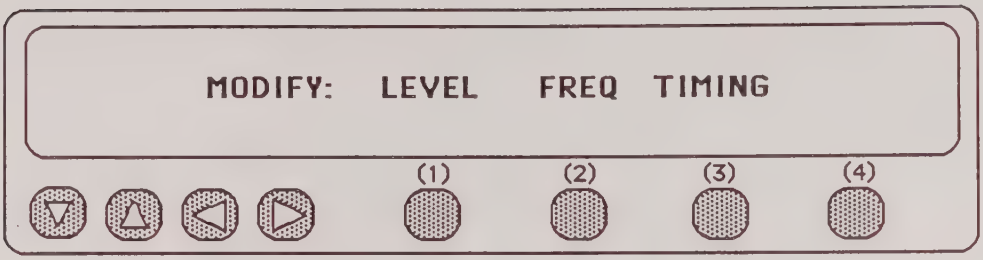


where X.X and Y.Y are the levels at which the low tone and high tone, respectively, are being sent.

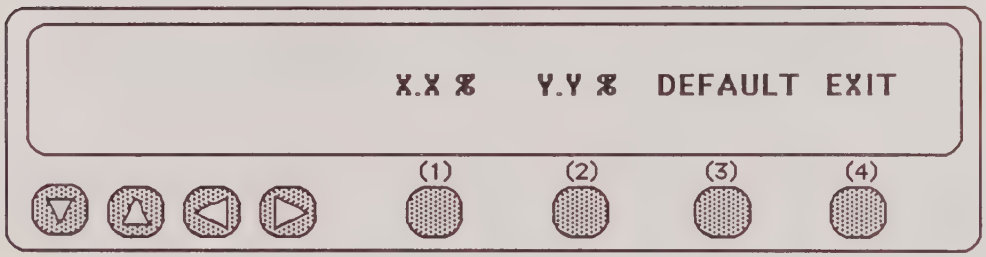
Use Softkeys 1 and 2 to select which tone level is to be modified and enter the desired level using the Numeric Keypad.

Use Softkey 3 to select the AT&T Standard levels.

Use Softkey 4 to return to the "MODIFY" display.



Pressing Softkey 2 (FREQ) will bring up the following display:

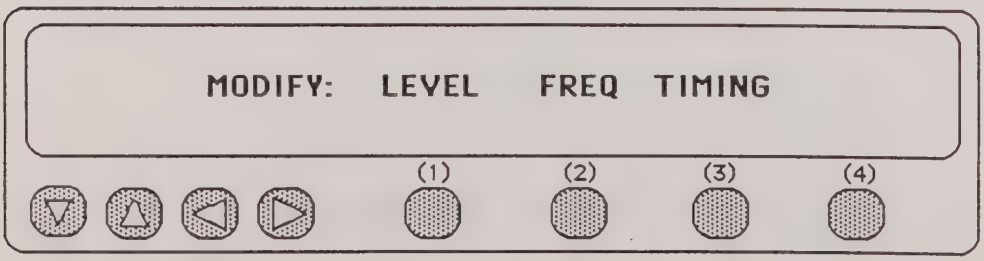


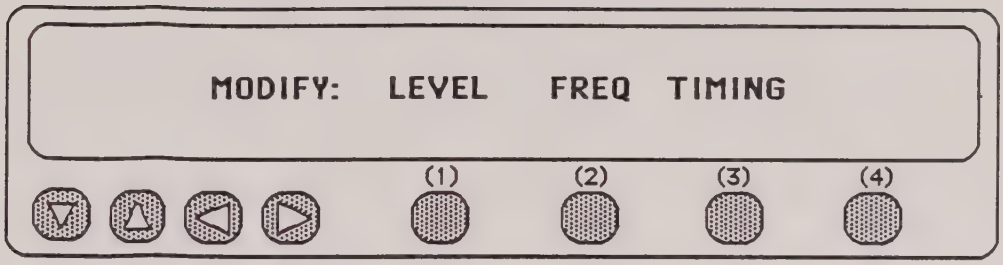
where X.X and Y.Y are the percentages above or below (+/-) the AT&T standard frequencies for each of the dual tones.

Use Softkeys 1 and 2 to select which tone frequency is to be modified and then enter the percentage (either + or -) numerically from the keypad and press ENTER. Typical values might be +/- 2% to +/- 5%.

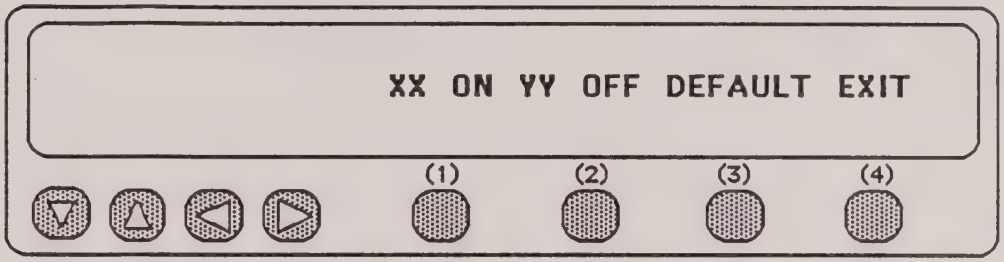
Use Softkey 3 to select the AT&T standard values without deviation.

Use Softkey 4 to return to the "MODIFY" display.





Pressing Softkey 3 (TIMING) brings up the following display:



where XX is the number of milliseconds the tones are ON and YY is the interdigit time (time between tones) in milliseconds.

Use Softkeys 1 and 2 to select which parameter is modified and then enter the desired amount numerically.

Use Softkey 3 to enter the AT&T standard values. These will vary depending upon whether MF or DTMF has been selected.

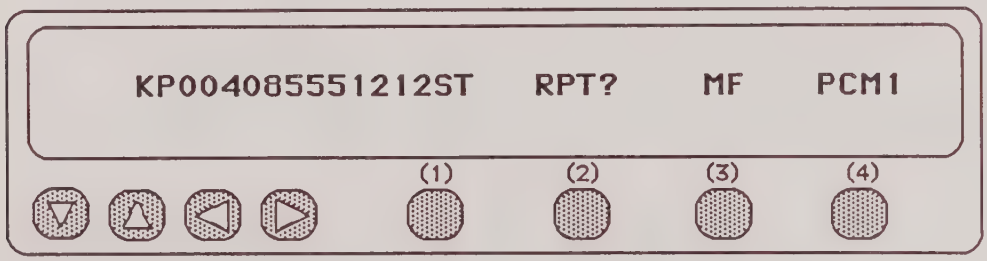
Use Softkey 4 to return to the "MODIFY" display.

Pressing any Function key will exit to that function, causing the modifications to be retained in non-volatile memory. In the DIAL/RING Function any sequence of digits which is outpulsed will be sent with the modifications set in the MODIFY SEND DIGITS menu. It is often convenient during testing to store the same outpulsing sequence with and without modifications. To illustrate this procedure let us take the simple case of an MF sequence and show how to store it for future recall with and without modification.

EXAMPLE: STORING A MODIFIED/UNMODIFIED SEQUENCE

The storing of an unmodified sequence followed by a modified sequence has use when the operator is routining a switch or checking performance limits. The idea is to first send a sequence that is "in spec." to verify proper operation and then send a sequence with modified parameters to "stress" the system to it's limits and verify that it is still capable of operating.

For this example, suppose that the desired sequence is the MF string, KP004085551212ST. This is entered in by the operator using the DIAL/RING Function and the numeric keypad as outlined in Section 3-7. The 930A display, after the number is entered, will look like:



Note that the PCM Trunk Type is used only for example purposes and the procedure described will work for any trunk type.

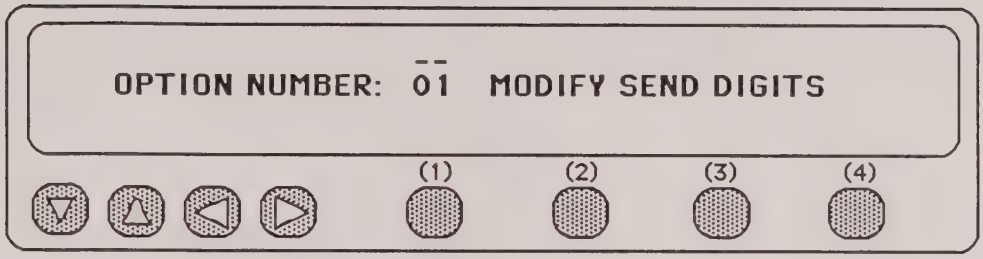
Once the operator has entered the desired sequence without modifications, as in the above example, the next step is to proceed to the Modify Send Digits menu. This is done to see that the sequence parameters are set to the DEFAULT (unmodified) values and then to store the sequence.

NOTE: THE OPERATOR MAY SKIP THE STEPS RELATED TO CHECKING FOR DEFAULT PARAMETERS IF THE DIAL/RING DISPLAY DOES NOT HAVE A ">" SHOWING BESIDE THE SIGNALING TYPE (MF IN THIS EXAMPLE).

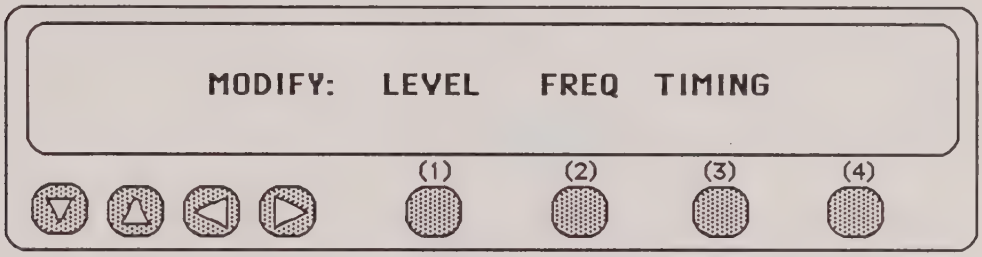
To store the unmodifed sequence follow the next series of steps:

Press the Option Menu Option Menu function key.

Use the UP/DOWN arrow keys to select Menu Option 1, if it is not already displayed.



Enter Menu Option 1 by pressing any Softkey and the display, in this case, will look like:

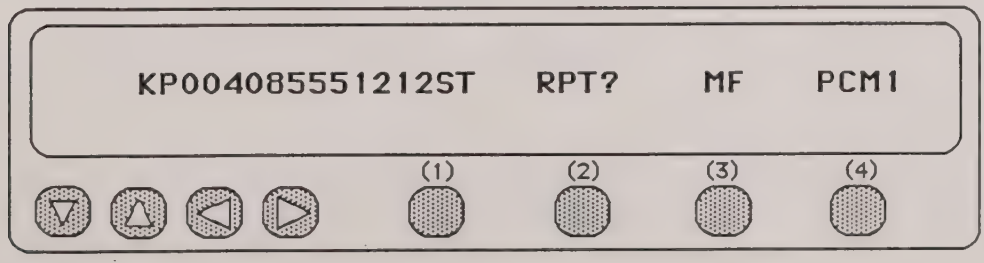


Press each Softkey from 1 to 3 and check the underlying fields to be sure that the parameters are set to the Default values. Press the Softkey labeled "DEFAULT" within each display. REMEMBER: If there was no ">" showing in the Dial/Ring display, the preceding few steps can be skipped.

For this example, assume that it is desired to store the unmodified sequence in register location 30. This is done by the following steps:

Press the Dial/Ring Dial/ Ring function key.

The 930A display will return to show the previously entered MF sequence as shown below:



Press the Store key, then 3 then 0

and then press the Enter key.

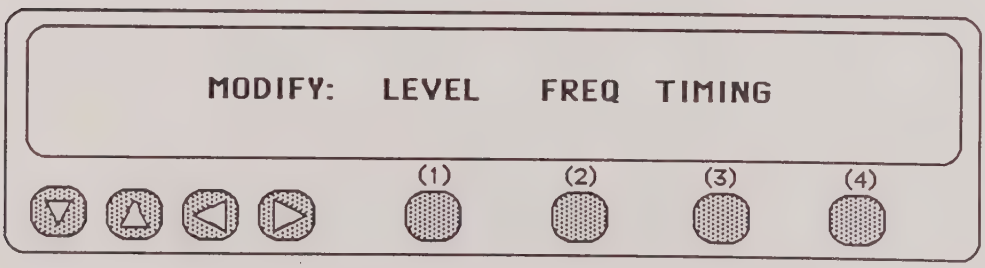
The unmodified sequence has now been stored in register location 30 and the Model 930A has automatically incremented to register location 31 which will save the operator from having to enter "31" in the upcoming series of steps.

The next step is to return to Menu Option 1 to modify some of the parameters. The steps are:

Press the Option Menu function key.

Use the UP/DOWN arrow keys to select Menu Option 1, if it is not already displayed.

Press any Softkey to enter the option and the display will be:



Once within Menu Option 1 the operator may, for example, desire to modify the frequency of the MF tones.

Suppose it is desired to modify the frequency of the tones 2% up and 3% down. To accomplish this modification perform the following steps:

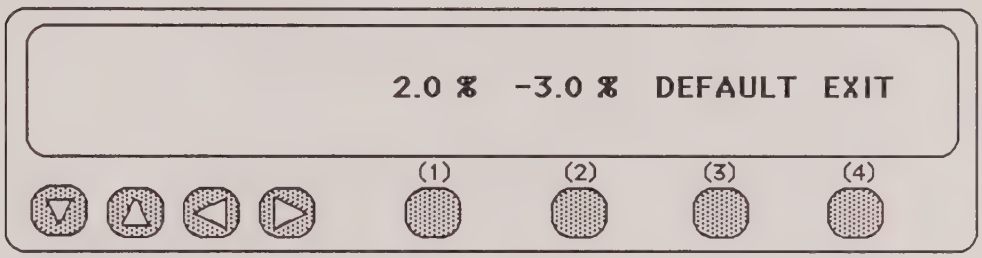
Press Softkey 1 and enter 2.0% numerically to increase the tone frequencies 2.0%. That is,

press [2] then [0] and then [ENT]

Then, press Softkey 2 and enter 3.0% and press the +/- key before pressing ENTER to enter the -3.0% value. That is, press

[3] then [0] then [D +/-] and then [ENT]

The 930A display will now look like:



Press the Dial/Ring [ ] or [Dial/ Ring] function key.

Now press [STO] and then [ENT]

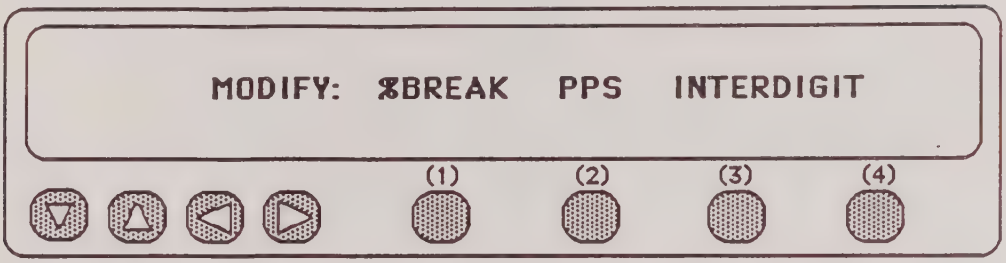
The modified sequence has now been stored in location 31 since the 930A automatically incremented to register 31 after the last storage.

The operator can now Recall "program" 30 to outpulse the normal MF sequence and then Recall 31 to outpulse the modified sequence. Of course, this procedure can be extended to as many modifications as the operator may desire and can also include sending modifications of multiple records.

Simply repeat the steps used above to modify the tone frequency for modifying and storing level changes or timing changes. Storing these changes in sequential register locations is desireable because the operator can step through the tests by simply pressing the RECALL NEXT key.

3-12.1.2 DIAL PULSE MODE

In the DP or Dial Pulse mode the display will appear as:



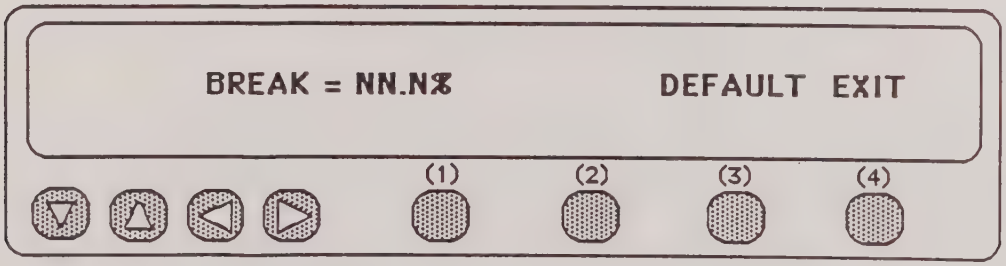
Use Softkey 1 to modify the On-Hook percentage of the pulse.

Use Softkey 2 to modify the number of pulses per second.

Use Softkey 3 to modify the interdigit timing.

Press any Function key to exit.

Pressing Softkey 1 (%BREAK) will bring up the following display:



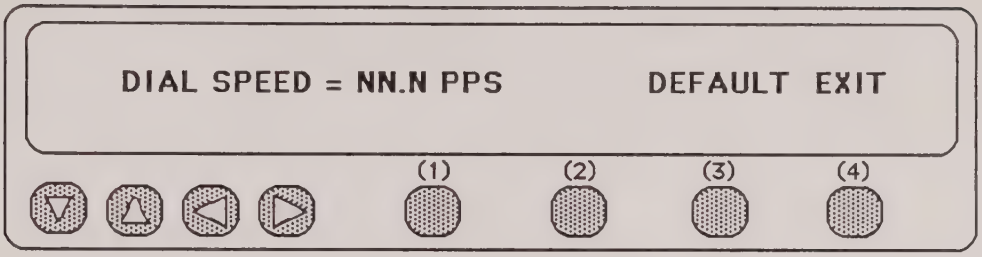
where NN.N is the percentage of each pulse which is On-Hook.

Enter the desired percentage numerically.

Use Softkey 3 to reset the % to the AT&T standard value if desired.

Use Softkey 4 to Exit.

Pressing Softkey 2 (PPS) brings up the following display:



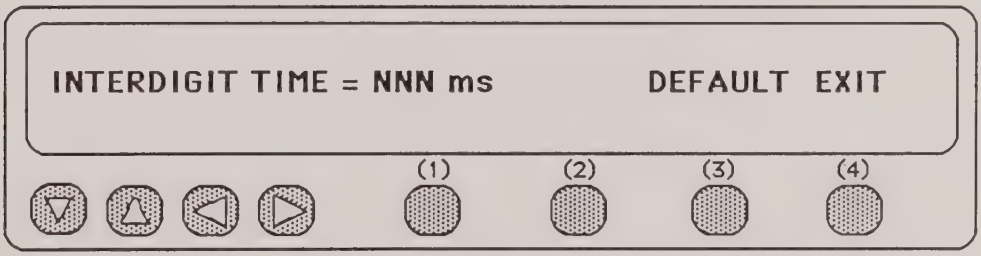
where NN.N is the number of pulses per second.

Enter any desired dial speed numerically.

Use Softkey 3 to reset the dial speed to the AT&T standard if desired.

Use Softkey 4 to Exit.

Pressing Softkey 3 (INTERDIGIT) brings up the following display:



where NNN is the number of milliseconds between digits.

Enter a new interdigit time numerically as desired.

Use Softkey 3 to return to the AT&T standard value if desired.

Use Softkey 4 to Exit.

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3-12.2 MULTIPLE RECORDS

Menu Option 2, MULTIPLE RECORDS, is included on all Model 930A's. This menu option is used for outpulsing very long strings of digits (>18 digits) or for multiple digit sequences such as those found in Equal Access, TSPS, and IDDD applications. The Model 930A can be programmed to pause, to wait for a wink, or to wait for the far-end to answer (go Off-Hook) between digit sequences. When using the MULTIPLE RECORD function, the operator will find it convenient to STORE the different sequences for future recall rather than input them manually each time. In fact, the MULTIPLE RECORDS menu option has been designed specifically to use the register locations where the digit strings are stored.

To use MULTIPLE RECORDS then, the desired digit strings should be entered (using DIAL/RING) and stored into test memory (using STO key) as described in Sections 3-7 and 3-7.1. Store one digit string, or "record", per register location. An example is provided at the end of this section.

NOTE:

Any modifications made in MODIFY SEND DIGITS (Menu Option 1) will also be stored. If no modifications are desired, go to Menu Option 1 and reset all parameters to their Default values before storing any of the strings.

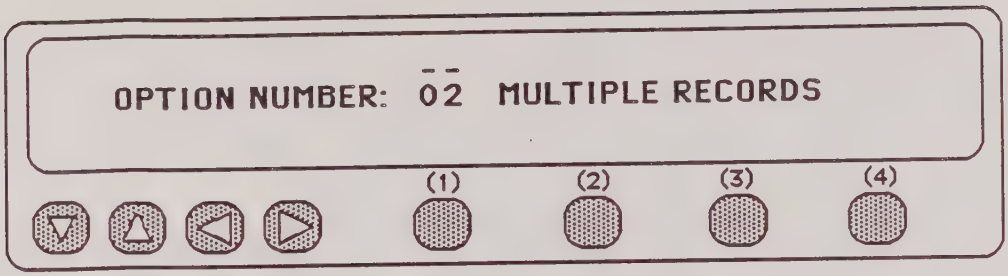
Make sure that the correct Trunk Type has been selected before storing any strings.

The procedure for using the Multiple Records function is outlined below. To begin:

Press the Option Menu Option Menu function key.

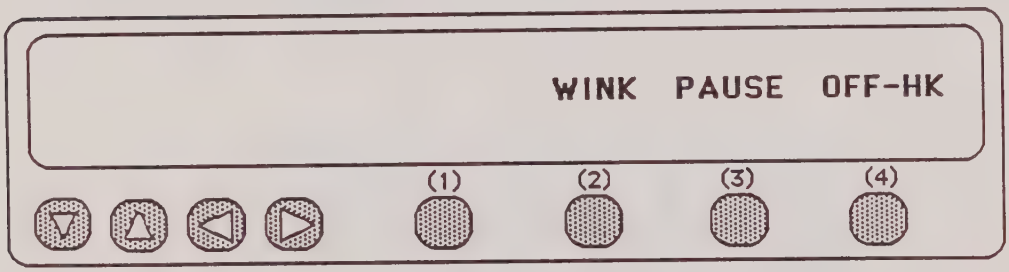
Use the UP/DOWN arrow keys to select Menu Option 2.

The display will appear as:



Press any Softkey to enter the menu option.

Once inside Menu Option 2, press the Clear CLR key and the display will show:



Numeric inputs are now treated as two digit storage locations (created in DIAL/RING) containing the digit sequences. Up to six records may be sent.

The CLR key clears the input sequences without destroying any stored values.

Softkey 2 programs the 930A to wait for a wink before proceeding.

Softkey 3 programs a one-second PAUSE in the sequence.

Softkey 4 programs the 930A to wait until the far end answers (goes Off-Hook) before proceeding.

Press any Function key to exit.

Use the front panel hook switch to go OFF HOOK to send the programmed sequence.

NOTE:

Manually going ON HOOK during a sequence will abort the program at the completion of the current record, pause, or wink. If the 930A is expecting a wink and none is supplied within 16 seconds, or the duration of the wink is greater than 600 milliseconds, then the wink will show FAIL on the display and the program will abort. A blinking cursor will appear in the display to indicate which wink has failed if the sequence contains more than one wink.

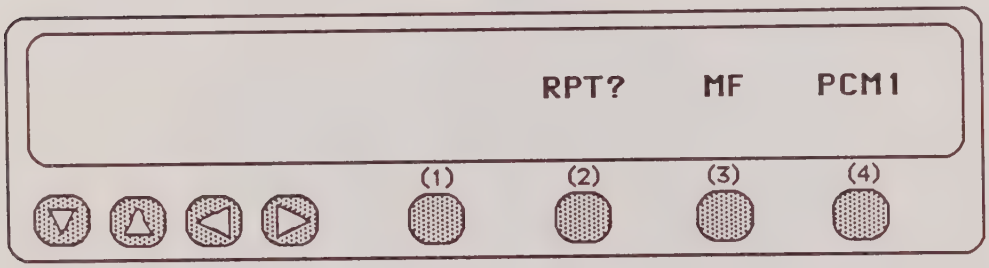
The best way to explain MULTIPLE RECORDS is through an example of a typical testing application. The following example is typical of an Equal Access (Feature Group D) application of the Model 930A.

EXAMPLE: USING MULTIPLE RECORDS IN EQUAL ACCESS

To simulate placing an Equal Access call from a Bell Operating Company (BOC) switch to an Interconnect Carrier (IC) through an Access Tandem switch the operator would perform the following steps:

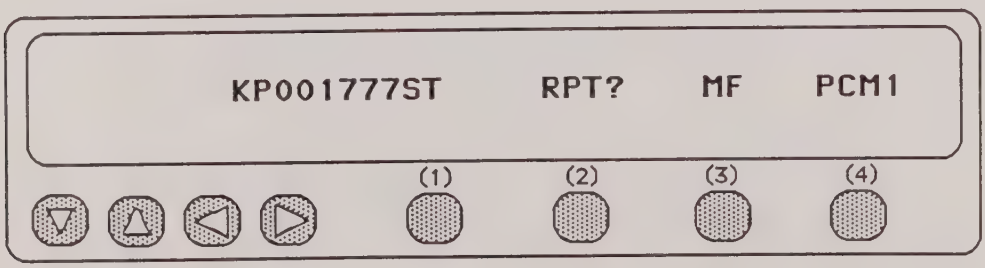
Press the Dial/Ring O **Dial/ Ring** function key.

Assume, for this example, that the display appears as:



Use the Numeric Keypad to key in the IC number, which, for example purposes, is assumed to be "KP001777ST", in MF. That is, press KP * ,then press 0 twice, then press 1 , then 7 three times, and finally press ST # .

This IC code is for example purposes only and the user should check the local codes in effect for the area. In this example, the display will now appear as:



Store this sequence in location 10, for example,

by pressing the STO 1 0 and

ENT keys.

Press the Clear CLR key to clear the display

and allow entry of the next sequence.

The next sequence in the Equal Access call includes the calling number. For example purposes, let this MF string be "KP004086623000ST". The first two digits are the information digit pair (for inter-LATA restricted lines), and then the 10 digit ANI number (calling number plus area code). The MF delimiters "KP" and "ST" surround the number. This string is entered in by the following series of keystrokes:

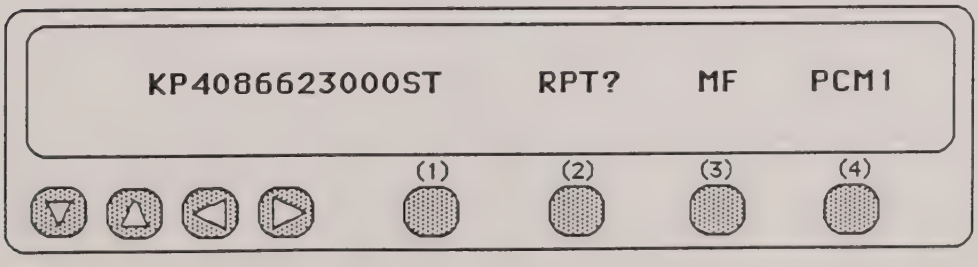
Press KP * ,then press 0 twice, then

press 4 0 8 6 6

2 3 0 0 0 and

finally, press ST # .

The 930A display should now look like:



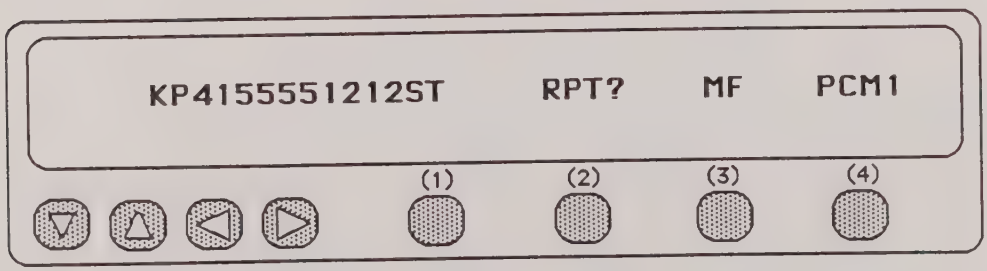
Store this sequence in location 11 by pressing the STO and ENT keys. Notice that the 930A automatically incremented the register location so that it was not necessary to enter the number 11.

Press the Clear CLR key to clear the display and allow entry of the next sequence.

The final string includes the called number (with Area Code). For this example the number used will be "4155551212". This will also be an MF sequence since this example is showing switch to switch connections. This does not have to be the case however, as any types can be mixed together in practice. To key in the above sequence:

Press KP *, then press 4 1 then press 5 four times, then 1 2 1 2 and finally, press ST #.

The 930A display will now look like:



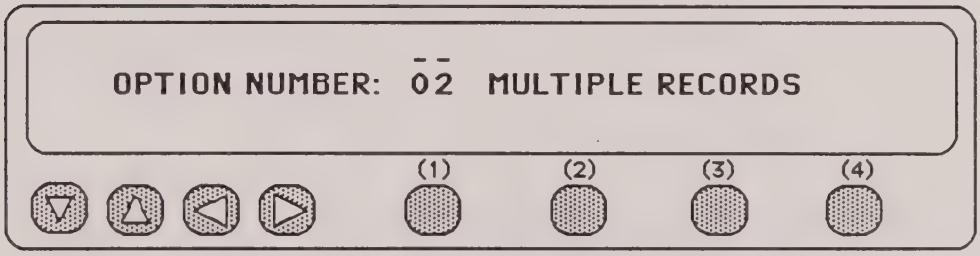
Store this sequence in location 12 by pressing the STO and ENT keys.

Having entered and stored the sequences to be outpulsed in this example, the next step is to go to the Multiple Records function and set it up to actually do the outpulsing. To accomplish this, perform the following steps:

Press the Option Menu key. Option Menu function key.

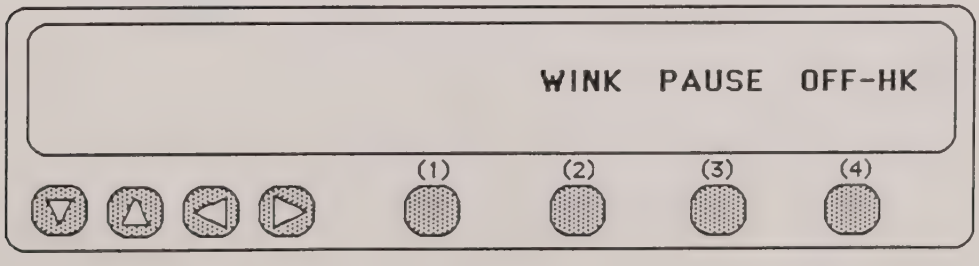
Use the UP/DOWN arrow keys to select Menu Option 2.

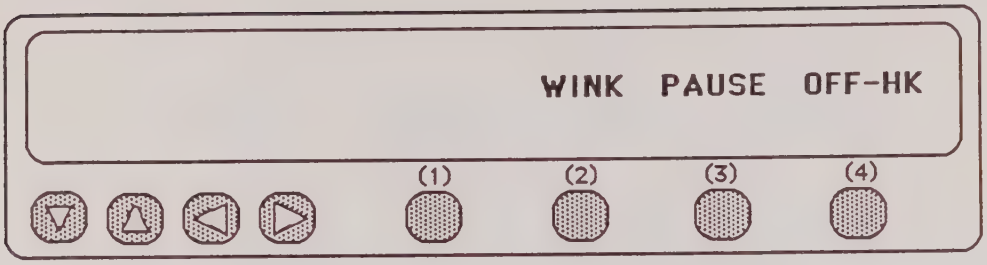
The 930A display should look like:



Press any Softkey to enter the menu option.

Once inside Menu Option 2, press the Clear CLR key and the display will show:





Now the Equal Access sequence can be input. The sequence consists of the previously stored IC Code number, the calling number, and the called number, separated by Wink supervision at the appropriate points. To input the sequence into the above display, do the following:

Press Softkey 2 which will insert a Wink at the beginning of the sequence (Wait for Wink).

Press [1] and [0] and then [ENT]

This instructs the 930A to outpulse the digits stored in register 10.

Press Softkey 2 again to insert another Wink between the IC Code number and the rest of the numbers. The 930A will wait for the Wink.

Press [1] twice and then [ENT]

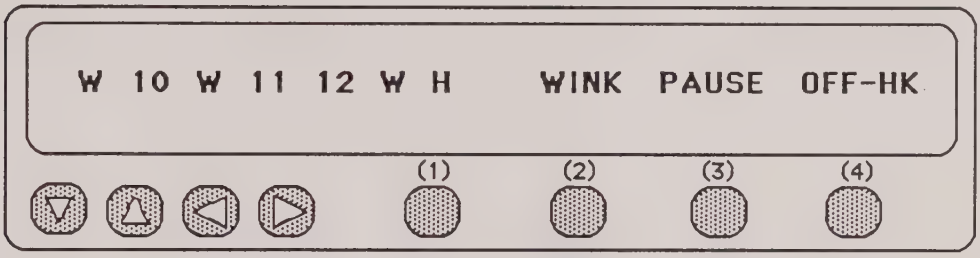
Press [1] and [2] and then [ENT]

This instructs the 930A to outpulse the digits in registers 11 and 12.

Press Softkey 2 to instruct the 930A to look for the final Wink.

Press Softkey 4 to instruct the 930A to expect the far end to go "Off Hook".

The program is now complete and the display will be as follows:



where 10 = KP001777ST, 11 = KP004086623000ST, and 12 = KP4155551212ST, in this example.

To execute the "program", place the front panel Hook Switch in the OFF-HOOK position and the sequence will be outpulsed. The operator can hear the outpulsing digit strings on the 930A's speaker and should also hear the far end answer. The Model 930A will also have automatically timed the winks. The wink timing can be examined by going to Menu Option 9: WINK TIMING. This option menu is discussed in Section 3-12.3.

The operator can either "send" Multiple Records from the 930A or "receive" Multiple Records (described in Sections 3-13.1 to 3-13.4) but cannot do both simultaneously from a single 930A. That is, a 930A cannot simulate the Originating and Terminating offices simultaneously. A full Equal Access test should be an end-to-end test with a 930A at each end so that Multiple Record sequences can be sent and received in both directions of transmission.

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3-12.3 WINK TIMING

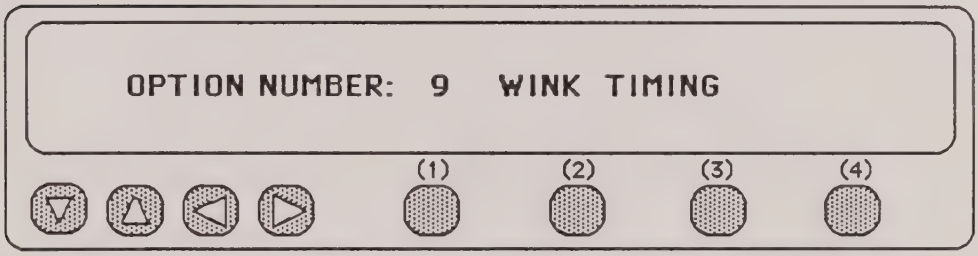
Menu Option 9: WINK TIMING is used with Menu Option 2: MULTIPLE RECORDS or with the RECEIVE RECORDS menu options (If Option 01 has been purchased). Menu Option 9 enables the user to time Supervision events.

To use Menu Option 9, first outpulse a multiple record sequence such as that used as an example in Section 3-12.2. That sequence expected a Wink and also expected the far end to go Off-Hook. The procedure for outpulsing the sequence is described in detail in Section 3-12.2. Perform the following steps to get to Menu Option: 9 WINK TIMING:

Press the Option Menu **Option Menu** key.

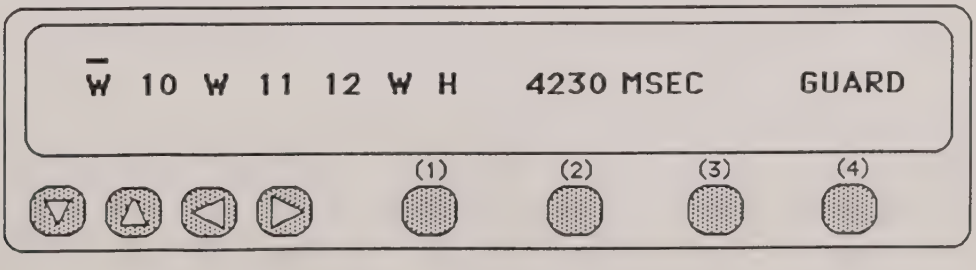
Use the UP/DOWN arrow keys to select Menu Option 9, WINK TIMING.

The 930A display will show:



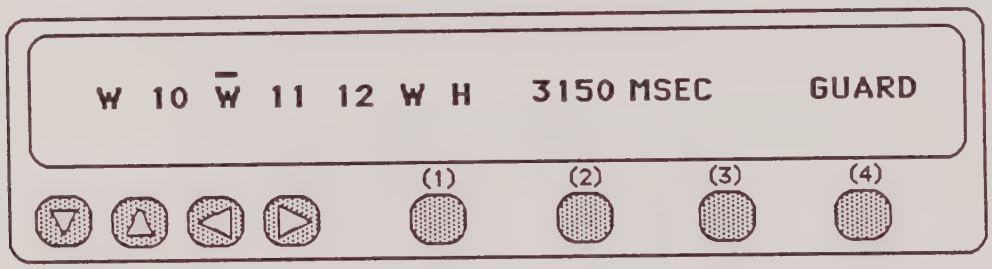
Enter the menu option by pressing any Softkey.

The display will show the sequence as it was keyed in under MULTIPLE RECORDS. For example, if the sequence from Section 3-12.2 is used, the display will appear as:



A flashing cursor will appear over the last completed wink or Off-Hook in the sequence. If a wink or Off-Hook has failed, the cursor will appear over the failed event. If the sequence has not yet been outpulsed, the cursor will appear over the first supervision event and all measurements will be zero. There will be a measurement, "NNNN MSEC", where NNNN is the length of time in milliseconds spent waiting for the event (the Guard Time). The word "GUARD" is displayed to label the measurement.

The Left and Right arrow keys allow the user to move the cursor within the multiple record sequence to examine any supervision event. For example, the user may want to examine the second wink in the sequence above. Using the Right arrow key, move the cursor over the second wink and the display will appear like:



The measurement always refers to the event under the cursor. The operation of the softkeys is as follows:

Softkeys 1 - 3 are inactive.

Softkey 4 is a wheel enabling the user to select that portion of the supervision event to be examined. If the event is a WINK, it selects between Guard time and Wink time. If the event is an Off-Hook, it selects between Guard time and the length of time Off-Hook.

The Guard period is measured in milliseconds. If the Guard period exceeds 16 seconds, the event "fails". In such a case the guard measurement display would read ">16000 MSEC", and the wink or off-hook measurement would read "FAILED". The wink period is also measured in milliseconds. If the event is a wink, it fails if the period exceeds 600 msecs. If the event is an off-hook, it fails if this period is less than 200 msecs. On units equipped with purchased option 01 the operator may also use Wink Timing to measure Delay Dial events in receive records mode. A Delay Dial event fails if the Guard period exceeds 20 milliseconds, or if the off-hook period exceeds 16 seconds.

3-12.4 BEEP ON ERROR

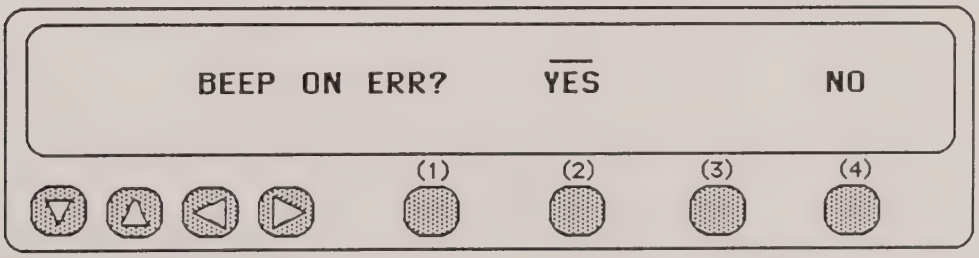
Option 15: BEEP ON ERROR provides the operator with an audible indication of various types of errors. These include errors of commission such as selecting a trunk type option that has not been installed. Since there are times when the operator does not desire to listen to the beep, this option menu provides the means to turn off the beep without cutting the wires to it. To control the BEEP do the following:

Press the Option Menu Option Menu key.

Use the UP/DOWN arrow keys

to select Menu Option 15, BEEP ON ERROR.

Enter the option by pressing any softkey and the display will appear as:



If the cursor appears over the YES field then the BEEP has been turned on. To turn it off, simply press Softkey 4 and then any Function key to exit the menu. The user is now free to make all the operating mistakes he wishes without the annoying BEEP to disturb him. To turn the BEEP back on simply go back to Option Menu 15 and, once inside the menu, press Softkey 2.

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3-13 RECEIVE RECORDS (OPT. 01 DP/MF/DTMF RECEIVER)

The Receive Records option group is composed of 5 menu options which are all installed in the Model 930A when Option 01: DP/MF/DTMF Receiver/Analyzer has been ordered. These menu options appear under the OPTION MENU key as:

1) OPTION NUMBER: 4 SET RECEIVE PARAMETERS
2) OPTION NUMBER: 5 SET RECEIVE SEQUENCE
3) OPTION NUMBER: 6 RECEIVE RECORDS
4) OPTION NUMBER: 7 ANALYZE RECORDS
5) OPTION NUMBER: 12 WINK MARGINING

The Receive Records group can be used in BRIDGE mode to monitor the interaction between equipment, or in the TERM mode, which enables the 930A to completely simulate terminating equipment. In either case the 930A will record the outpulsed digits it receives. In the TERM mode the 930A will supply supervision. In the BRIDGE mode, it will look for and time supervision events (Winks, Off-Hooks, etc.). The 930A breaks an outpulsing sequence into groups of digits and supervision events. The digit groups, which can be MF, DTMF, or DP sequences, are called Records. The supervision events are divided into Winks, Pauses or Delays, and Off-Hooks. The following sub-sections provide a detailed description of the use and operation of each of the five Menu Options which comprise the Receive Records group.

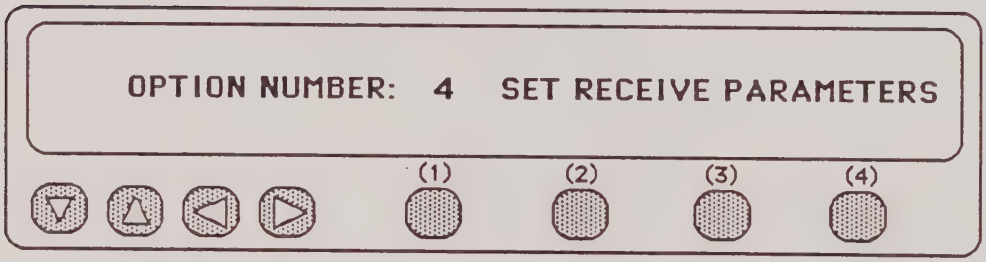
3-13.1 OPTION NUMBER: 4 SET RECEIVE PARAMETERS

The length and type of each record is set in Menu Option 4. A string of 10 DTMF digits would be one record for example. This menu option allows the operator to tell the 930A what to expect in the way of length and type of records. The user should set up the appropriate parameters in this menu option, before attempting to receive multiple records, by performing the following steps:

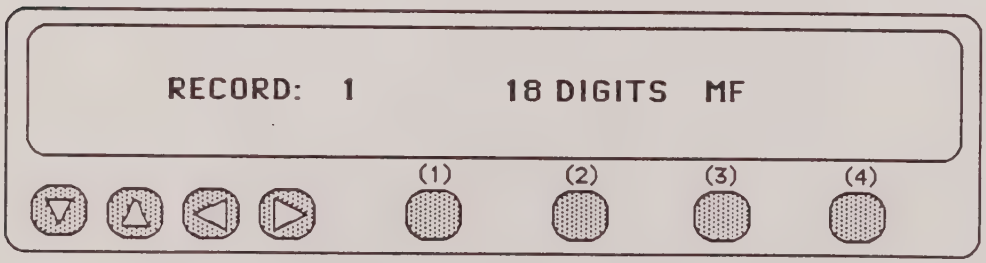
Press the Option Menu **Option Menu** key.

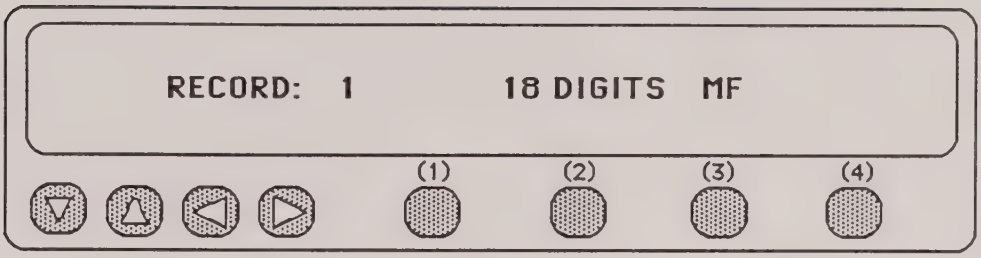
Use the UP/DOWN arrow keys to select Menu Option 4, SET RECEIVE PARAMETERS.

The 930A display should be:



Press any Softkey to enter the menu option. A typical display is shown below:





The functions of the front panel keys within this menu option are as follows:

Numeric input is interpreted as the number of digits expected in the record. A length of up to 18 digits may be specified. Larger entries will be truncated. Start and Stop codes (KP, ST, #, and *) count as digits.

The UP/DOWN arrow keys select the record number which is displayed above them. Up to 4 records may be used.

Softkeys 1, 2, and 4 are inactive.

Softkey 3 is a wheel which allows the user to select either MF, DTMF, or DP digits.

If a received digit string is longer than the length specified, it will spill over into the next record. A string of more than eighteen digits should be set up as two or more records.

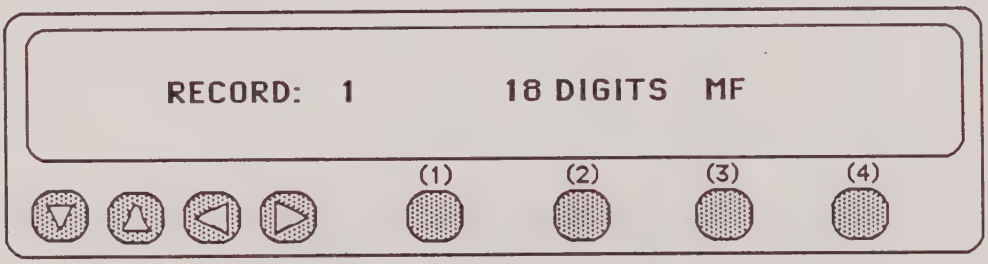
IN DIAL PULSE AND DTMF:

The exact length of the incoming record must be specified if the 930A is to provide or measure supervision at the end of the record. If no supervision is required the 930A can be considered a wide-open receiver. When one record fills, another will be started and this will continue until record 4 is full.

Neither DP nor DTMF strings contain their own delimiters. This presents a problem in multiple record sequences such as TSPS where there exists a mixture of MF (which does have delimiters) and DTMF digit strings.

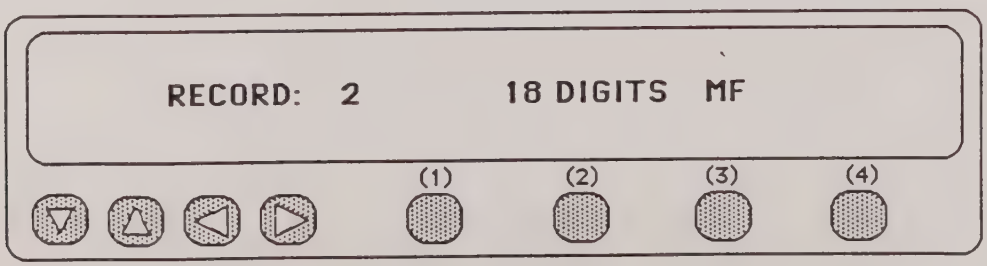
Using a TSPS trunk as an example, the first two records may be MF while the third record is DTMF (Customer's Calling Card number). Since the calling card number consists of the user's phone number with area code plus a 4 digit personal identification number, it is 14 digits long.

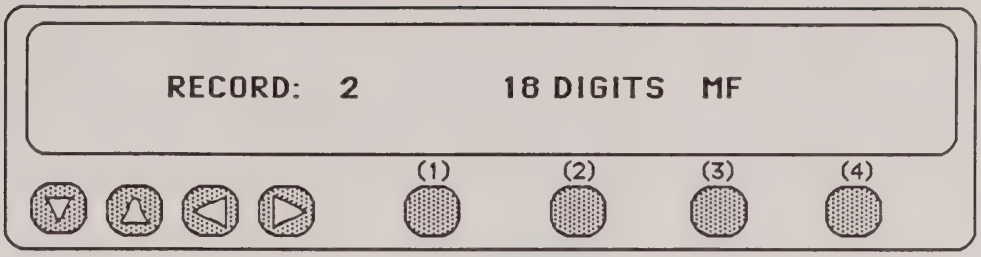
The following displays show the set up of the parameters for this example beginning with record number 1 of the 3 record sequence:



Press the UP arrow key if no changes are necessary.

The display will increment to the next record number which, in this example, is also an MF string:



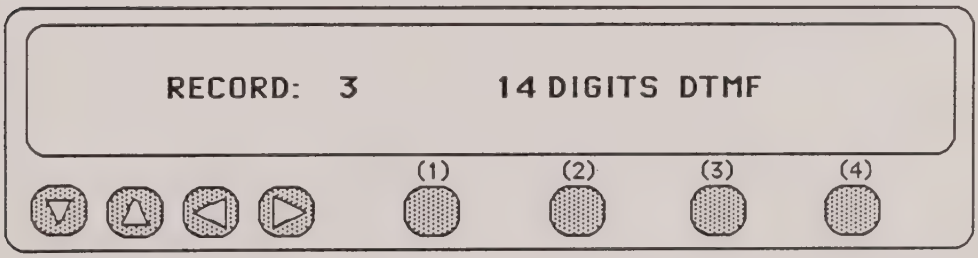


Press the UP arrow key if no changes are necessary.

The 930A display will increment to the third record. The third record, in this example, is a DTMF string. Since DTMF has no delimiters and it is desired to measure supervision events, the exact length of the string (14 digits as mentioned above) must be entered. To do this, perform the following steps:

Press 1 then 4 and then ENT

Press Softkey 3 until DTMF is displayed.



Press the Option Menu Option Menu key to exit.

IN MF:

The digit string contains its own delimiters, and the 930A will begin a new record whenever it receives a KP, or when the current record is full, whichever comes first. A record is full when the number of digits received exceeds the number specified for that record.

If the 930A is expected to provide a wink at the end of a record, it will do so when it detects an ST, STP, ST2P, or ST3P, or when the current record is full. Since an MF string always contains delimiters, the user need not specify the exact length of the digit string. Instead, it is probably best to simply use the default value of 18 for MF records.

3-13.2 OPTION NUMBER: 5 SET RECEIVE SEQUENCE

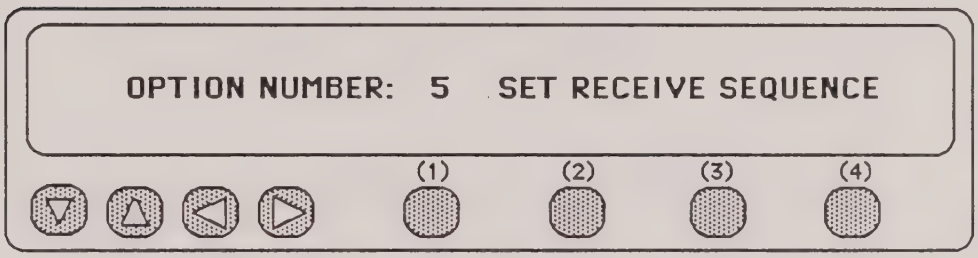
After the Receive Parameters have been set up, Menu Option 5 is selected to program the 930A to expect a sequence of records (digit groups) and supervision events. To select Menu Option 5, perform the following steps:

Press the Option Menu **Option Menu** key.

Use the UP/DOWN arrow keys

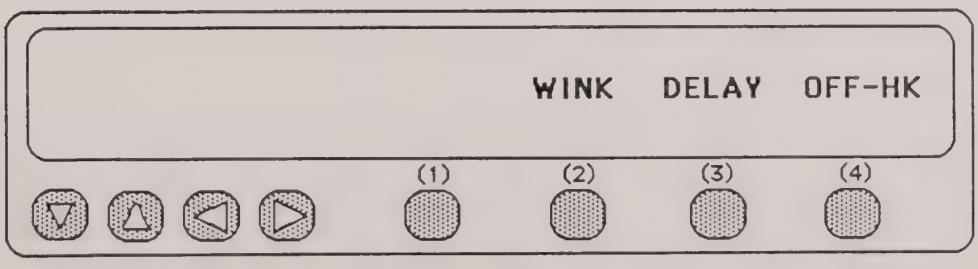
to select Menu Option 5, SET RECEIVE SEQUENCE

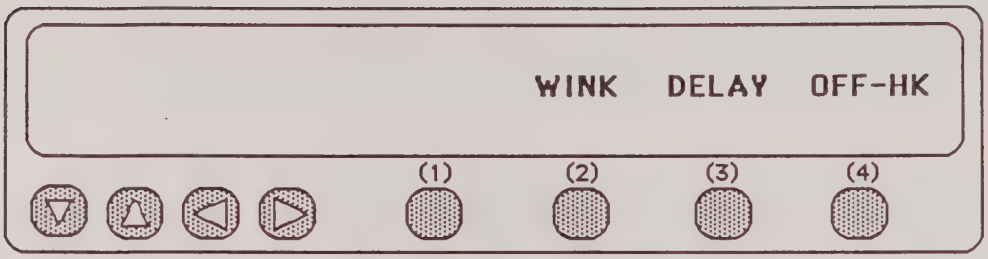
The 930A display will be:



To illustrate the use of this menu option, the example of an Equal Access type call presented in Section 3-12.2 will be used. To begin, perform the following steps:

Press any Softkey to enter the menu option
and the display will be:





The operation of the front panel keys is as follows:

The Left Arrow key places a one second pause in the sequence.

Numeric input is treated as a record number (1-4).

The Clear CLR key clears the sequence.

Softkey 1 is inactive.

Softkey 2 places a Wink in the sequence.

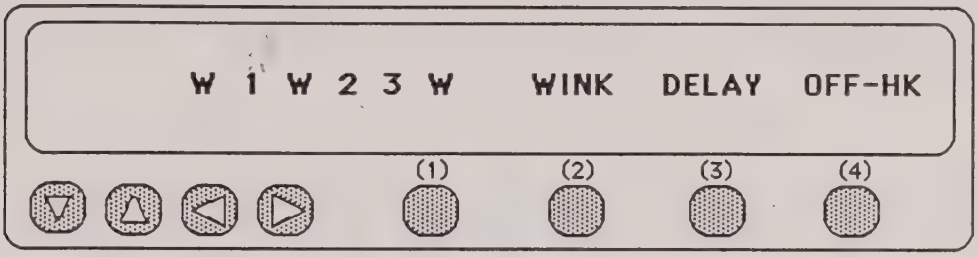
Softkey 3 places a Delay (for Delay-Dial) in the sequence.

Softkey 4 places an Off-Hook in the sequence.

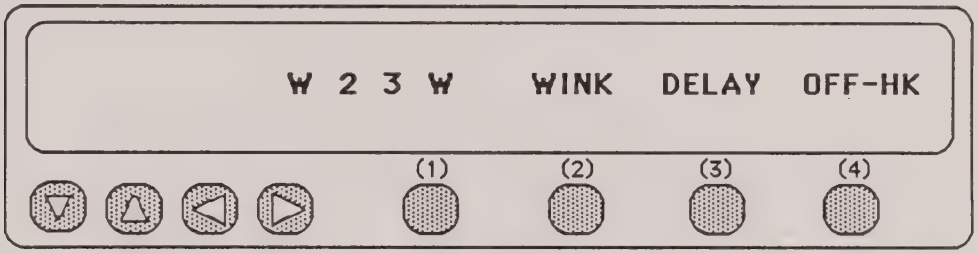
EXAMPLE:

When a call is placed to an Interconnect Carrier through an access tandem switch, the originating office expects a wink to indicate Receiver Ready. It then sends an ID code group of MF digits (for example "KP001777ST"), expects another wink, sends the calling number and the called number (also MF strings), and expects a final wink to acknowlege completion.

If the 930A is programmed to take the place of the access tandem and the IC then the sequence will look like:



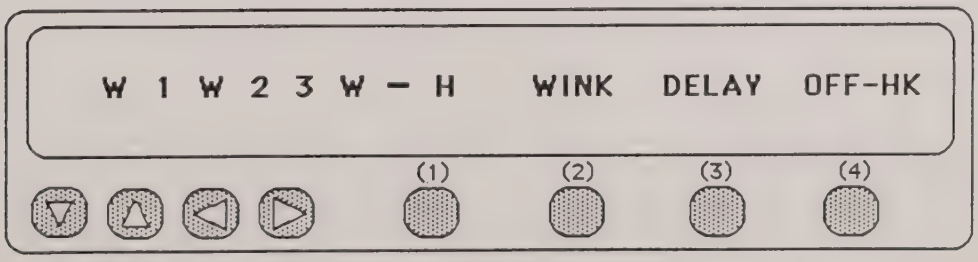
To simulate the IC alone, simply begin the sequence with the second wink, since the access tandem would provide the first wink and strip off the ID code under these conditions. The sequence, in this case, would look like:



By adding a pause and an Off-Hook to the end of the sequence, the call is allowed to "go through" and the 930A becomes the called party as well. To set this sequence up, assume that the three record sequence is being used and do the following:

Use the Left Arrow key to insert a one second pause in the sequence. NOTE: Softkey 3 is for delay dial, not pause.

The sequence, under these conditions, will look like:



In BRIDGE mode the 930A will not provide the expected supervision since it is in a monitoring mode. The 930A will monitor the interaction between the originating and terminating equipment. This allows the user to receive the incoming digits, and to time the winks and supervision events provided by the terminating equipment.

NOTE:

If the 930A has been equipped to test PCM trunks then the THRU mode is the monitor mode for that option. BRIDGE and TERM affect the impedance only. For a further discussion of the PCM option refer to Section 3-14.

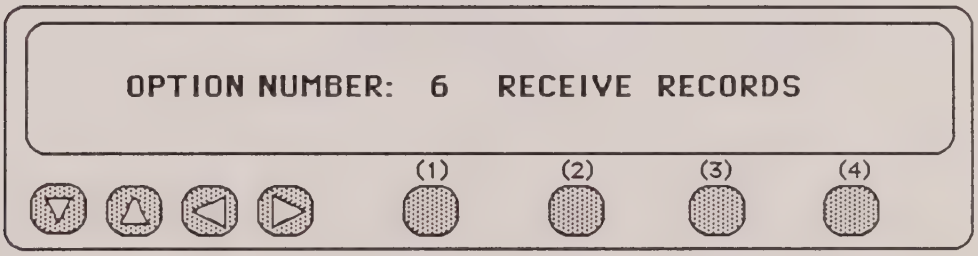
3-13.3 OPTION NUMBER: 6 RECEIVE RECORDS

Once the operator has defined the length and type of expected records in Menu Option 4 and the sequence of records and supervision in Menu Option 5, then selecting Menu Option 6 allows the 930A to receive records and to measure or provide answer supervision. Select Menu Option 6 in the same manner as any other menu option by the following steps:

Press the Option Menu key.

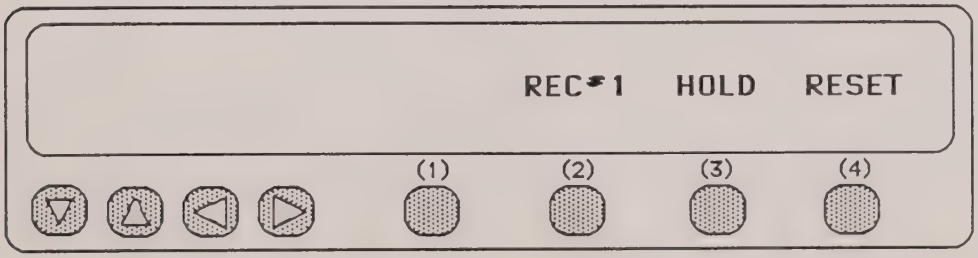
Use the UP/DOWN arrow keys to select Menu Option 6, RECEIVE RECORDS.

The 930A display will appear as shown below:



Press any softkey to enter the menu option.

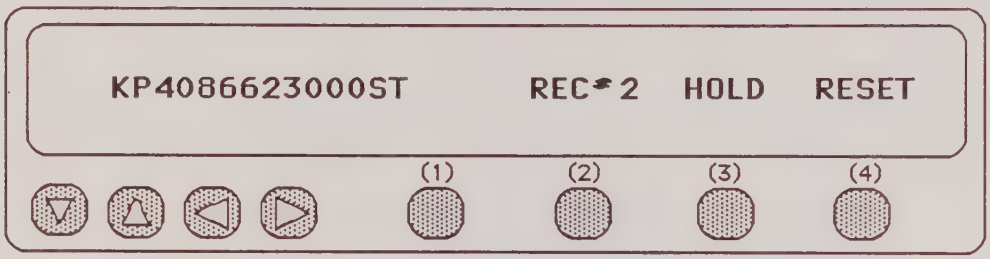
The 930A display will look like:



After entering Menu Option 6, press Softkey 4 (RESET) to clear any old records from memory and to set the 930A to receive record 1.

Incoming digits will automatically be recorded, records will be updated, and the programmed supervision will be provided or measured. When the sequence is complete, or to interrupt, press Softkey 3 to put the 930A on "Hold".

A typical Menu Option 6 display, after receiving a record, might appear as:



The functions of the front panel keys in Menu Option 6 are as follows:

The Hook Switch does not control supervision. Supervision is under software control.

NOTE: If receiving records in BRIDGE or THRU modes, place the Hook Switch in the "OFF HOOK" position.

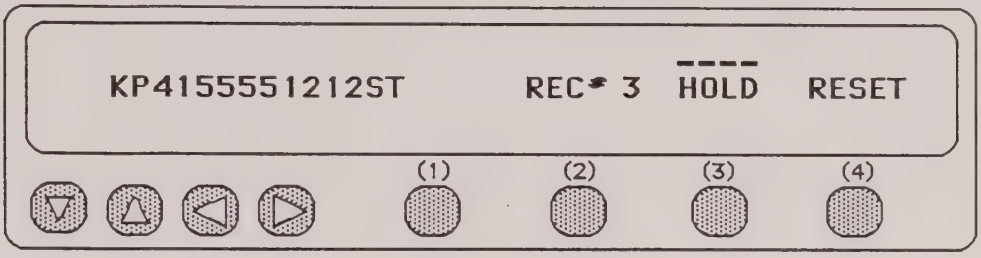
The numeric keypad is inactive.

Softkey 1 is inactive.

Softkey 2 is inactive unless the 930A is on "HOLD".

Softkey 4 resets the sequence and takes the 930A off "HOLD".

When the 930A is placed on "HOLD", a flashing cursor appears over the word HOLD and the 930A stops receiving digits. This freezes all records in their current state.



When on "HOLD", additional front panel key functions are:

The Up/Down arrow keys change the record whose digits are displayed. That is, the user may scroll through the other stored records.

Softkey 2 is a wheel which can also be used to scroll through and select records 1-4.

Softkey 3 takes the 930A off "HOLD" if it is on and vice versa.

The Hook Switch now controls supervision.

Timing information, for winks and other supervision events, is available in Menu Option 9 (WINK TIMING) if Option 01 MF, DTMF and DP Receiver/Analyzer has been installed in the 930A. This information is obtained only when the 930A is in a Monitor mode (BRIDGE in analog trunks, THRU in PCM).

The 930A will send an answer-back tone at the end of a record sequence if one has been selected in the SEND TONE function. This provides an audible acknowledgement that the call has completed successfully. If the 930A is on "HOLD", a talk path is also established for a headset or butt-in using the front panel connections.

3-13.4 OPTION NUMBER: 7 ANALYZE RECORDS

When purchased option 01 has been installed in the Model 930A, Menu Option 7: ANALYZE RECORDS is available to enable the user to measure the interdigital times. That is, the user can measure the ON and OFF times of the pulses which make up an individual received record.

For instance, the nominal ON and OFF times for a DTMF pulse steam are 50 milliseconds each. Received DTMF records from a "good" source would be expected to be within a few milliseconds of the nominal 50 millisecond value. Values far outside the nominal or large discrepancies between digits in the same record string are symptoms of signaling troubles.

Menu Option 7 becomes useable after a string or a sequence of digits has been received under Menu Option 6: RECEIVE RECORDS. To use Menu Option 7 perform the following steps after the records have been received.

To get out of Menu Option 6:

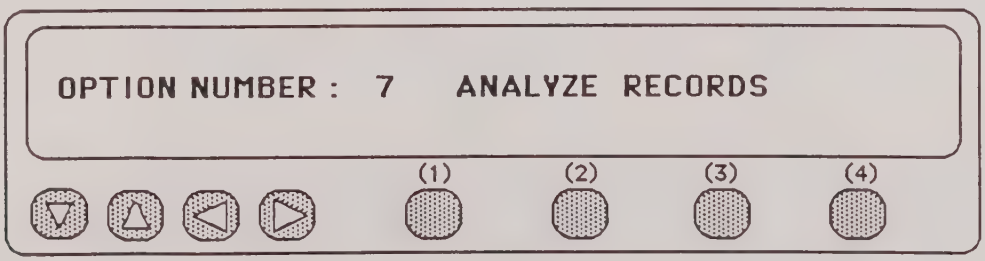
Press the Option Menu O **Option Menu** key.

Once outside the Option Menu display:

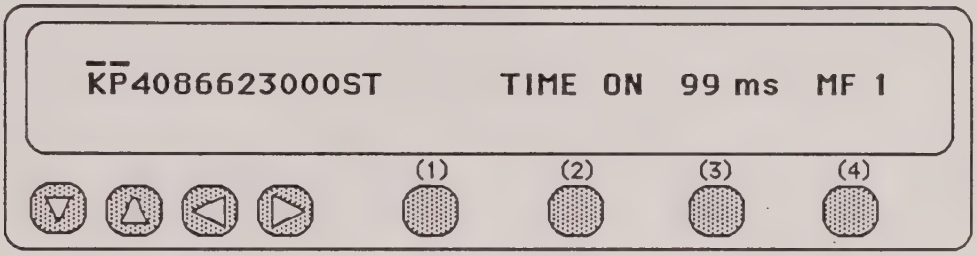
Use the UP/DOWN arrow keys

to select Menu Option 7: ANALYZE RECORDS.

The display will appear as follows:

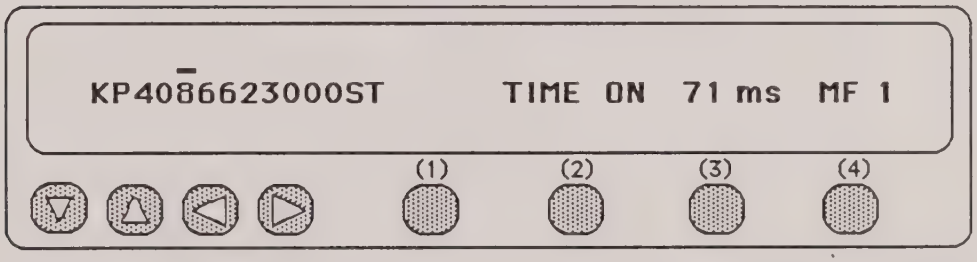


Press any Softkey to enter the option. A typical example of a display is shown below:



The display, in this example shows an MF record. The cursor over the "KP" denotes the digit currently being measured. In this case the ON time of the KP pulse has been measured to be 99 milliseconds.

Use the LEFT/RIGHT arrow keys to position the cursor over the digit to be measured and the display will, for example, look like:



Pressing Softkey 2 will cause the display to change from the TIME ON to the TIME OFF measurement value.

Softkeys 1 and 3 are inactive.

Softkey 4 controls which record in a Multiple Record sequence is displayed.

3-13.5 OPTION NUMBER: 12 WINK MARGINING

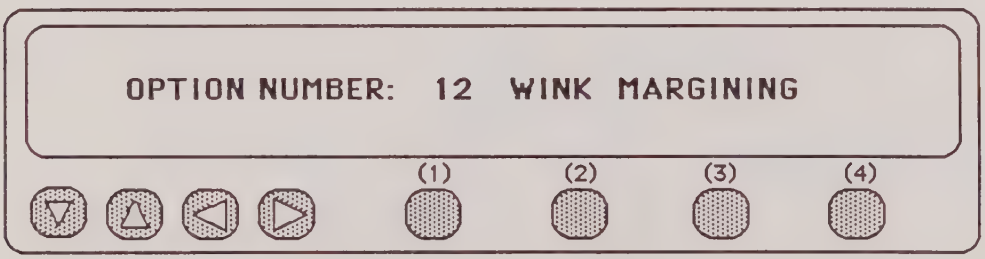
The Model 930A includes Wink Margining as part of Option 01 (MF, DTMF, and DP Receiver/Analyzer). If this option has been purchased and installed, then the 930A will enable the user to modify the wink parameters. The Wink Margining menu option is used to modify the length of time the 930A waits before giving a wink and to modify the length of the wink itself. This feature is most useful in determining Pass/Fail margins of transmitting equipment.

Select Menu Option 12 in the same manner as any other menu option by the following steps:

Press the Option Menu Option Menu key.

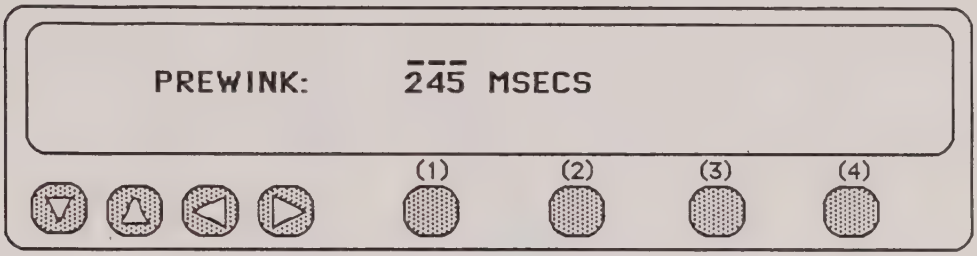
Use the UP/DOWN arrow keys to select Menu Option 12, WINK MARGINING.

The 930A display will appear as shown below:



Enter the menu option by pressing any Softkey.

Once inside Menu Option 12, the display will show the default value of the "Pre-Wink", or the last value entered.

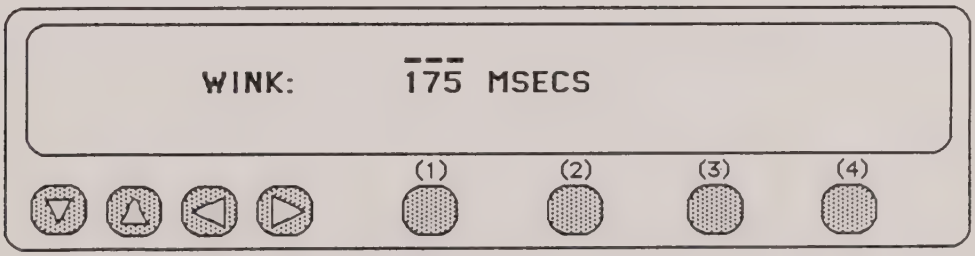


The "Pre-Wink" time is the number of milliseconds the 930A will wait after line seizure (or the end of a record) before giving a wink. The range of permissible values lies between 55 and 995 msecs. The factory set default value is 245 msecs. This option has a resolution of 10 msecs. and an accuracy of +/- 10 msecs. The front panel keys function as follows:

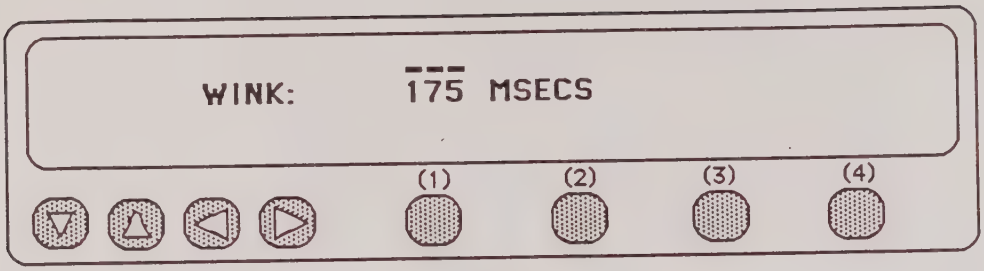
Input from the numeric keypad is treated as a pre-wink period.

Pressing ENTER or any Softkey locks in the displayed pre-wink value and advances to the next screen.

The display will then read the Wink Time default value of 175 milliseconds or the last value entered:



This is the number of milliseconds the 930A will remain Off-Hook during a wink. The range of permissible values lies between 35 and 995 msecs. The factory set default value is 175 msecs. The accuracy is +/- 10 msecs. and the resolution is 10 msecs.



Input from the numeric keypad is treated as a wink period.

Pressing ENTER or any Softkey locks in the displayed wink value and Exits to the Option Menu.

3-14 PCM TRUNK TYPE OPTION (INSTALLED OPT. 8 OR 9)

This section of the manual describes the operation of the 930A when either Option 8 (PCM Channel Access) or Option 9 (Dual Direction Drop and Insert) has been installed in the unit.

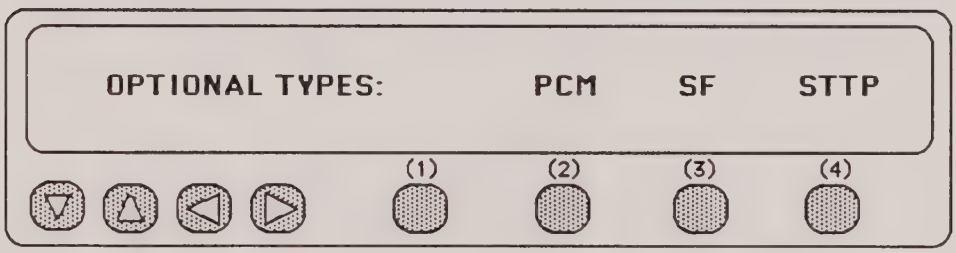
To begin, the operator must select the PCM Trunk Type. To do this, perform the following steps:

Press the Trunk Type Trunk Type Function key

to display the currently selected Trunk Type.

Use the UP/DOWN arrow keys to

page through the available displays until the following display appears:



The front panel keys function as:

Pressing the Up Arrow or Softkey 1 will page through the trunk types starting at Loop Supervision.

Pressing the Down Arrow key will page backward through the trunk types from E&M type V.

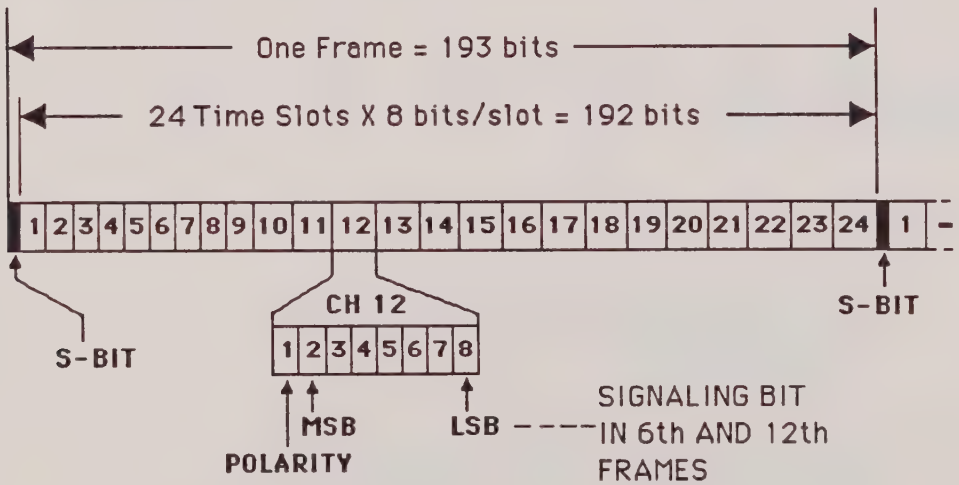
Press Softkey 2 to enter PCM (if the option has been installed).

Softkey 3 is for SF supervision (if installed) and Softkey 4 activates the STTP interface (if installed).

3-14.1 DS-1 PCM TRANSMISSION

Before describing the operation of the 930A front panel keys and how the 930A can be used to test PCM trunks, it is worthwhile to first review some of the fundamentals of DS-1 (T-1) PCM transmission.

The Model 930A works with DS-1 (T-1) systems only. The T-1 Carrier system, introduced by AT&T in 1962, is a Time Division Multiplex (TDM) system that places 24 trunk circuits onto a single span line. Each individual trunk circuit consists of a Pulse Code Modulated (PCM) representation of the information which was on the message circuit input (normally speech). The input is sampled at an 8KHz rate and encoded into PCM using an 8 bit code which works out to the well known 64 Kbps data rate for an individual PCM channel. Since there are 24 channels, plus another 8 Kbps of overhead framing bits, the overall T-1 rate can be seen to be 1.544 Mbps. The T-1 system organizes these channels in a continuous bit stream which uses additional bits, called Framing bits, to enable receiving equipment to synchronize and recover the information. In order to synchronize the transmission the synch pattern is repeated every twelve frames and this gives rise to the so-called Superframe format. The following diagram illustrates a typical frame of T-1.


One Frame = 193 bits
24 Time Slots X 8 bits/slot = 192 bits
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 1
S-BIT
S-BIT
CH 12
1 2 3 4 5 6 7 8
MSB
LSB
POLARITY
SIGNALING BIT
IN 6th AND 12th
FRAMES

The frame bit, or S-bit, occurs after every 192 information bits. The sync pattern is generated by looking at the S-bits in twelve successive frames. The sync pattern for Superframe format is 100011011100 and repeats every 12 frames.

In addition to the message information which is encoded, the T-1 system also includes supervision information by "robbing" the least significant bit from the sixth and twelfth frames and using these "A" and "B" bits for sending supervision.

The S-bit pattern, in turn, is broken down into two 6 bit long patterns called the Terminal Framing and Signaling Framing patterns.

	S-BIT	
FRAME NUMBER	TERMINAL FRAMING F_T	SIGNALING FRAMING F_S
1	1	-
2	-	0
3	0	-
4	-	0
5	1	-
6	-	1
7	0	-
8	-	1
9	1	-
10	-	1
11	0	-
12	-	0

Once the terminal equipment has acquired frame sync, it is able to identify the individual time slots and this is how the receiving equipment is able to properly decode the individual messages.

There are several channel numbering schemes in use and they are based primarily upon the vintage of the digital channel banks which generated them. These equate the time slots to individual channel numbers and it was not always the logical one to one relationship which one might assume. The three common sequences are:

	CHANNEL NUMBERING		
TIME SLOT	PREFERRED SEQUENCE (D3/D4)	D1D SEQUENCE	D2 SEQUENCE
1	1	1	12
2	2	13	13
3	3	2	1
4	4	14	17
5	5	3	5
6	6	15	21
7	7	4	9
8	8	16	15
9	9	5	3
10	10	17	19
11	11	6	7
12	12	18	23
13	13	7	11
14	14	19	14
15	15	8	2
16	16	20	18
17	17	9	6
18	18	21	22
19	19	10	10
20	20	22	16
21	21	11	4
22	22	23	20
23	23	12	8
24	24	24	24

Since there exist many installed channel banks of each type it is necessary for a test set such as the Model 930A to provide access to any of them.

The Model 930A provides access to the channel selected so that VF signals and supervision can be sent and received. In this brief summary of T-1 transmission, the topics of Extended Superframe Format (ESF), Clear Channel Capability (B8ZS), and Common Channel Interoffice Signaling (CCIS) have purposely been left for a future T-1 appendix to this manual, since these topics deserve a more in-depth discussion than is desirable in this Section.

With the conclusion of this brief review of PCM Transmission, the operation of the front panel keys and PCM Trunk testing using the Model 930A can be discussed.

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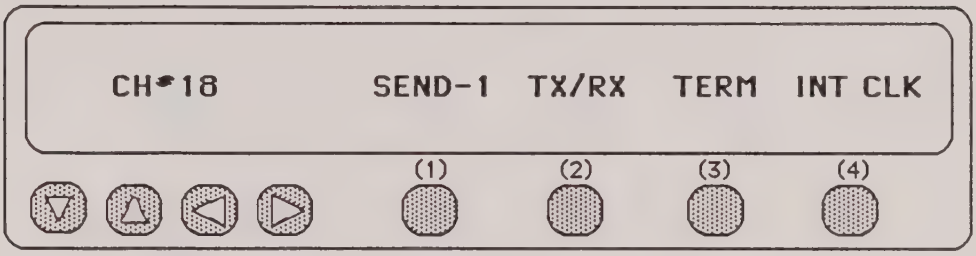
3-14.2 FUNCTION OF FRONT PANEL CONTROLS IN PCM

If either Option 08 (DS-1 PCM Send/Receive) or Option 09 (DS-1 PCM Dual Direction Drop and Insert) has been installed then pressing Softkey 2 (labeled PCM) in the OPTIONAL TRUNK TYPE screen (Refer to Section 3-14) will activate the PCM interface and bring up the primary PCM Option Screen. A typical example of this display is shown below:



In the above example of a typical primary option screen the displayed parameters are:

"CH#18" indicates that PCM channel 18 has been selected.

"SEND-1" means that the output from the 930A is on the PCM-1 OUT jack.

"TX/RX" means the 930A is in the Send/Receive mode.

"TERM" means that the PCM input is terminated in 100 ohms.

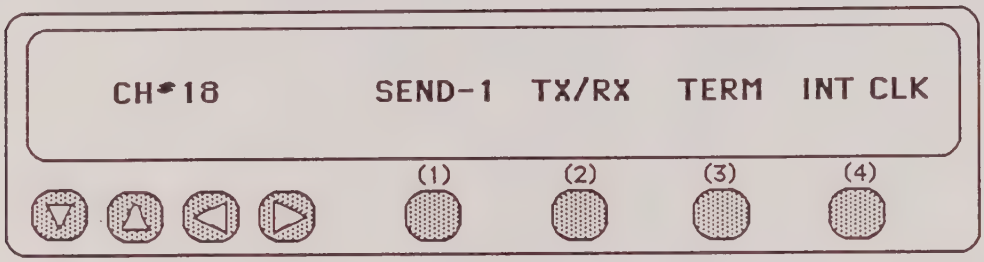
"INT CLK" means that the 930A is supplying clock using its own internal crystal oscillator.

The PCM interface has too many parameters to be set from a single screen, so five screens, accessed through the Left and Right Arrow keys, are used.

1) The PCM Primary Option screen
2) The Supervision Lamp option screen
3) The Transmit Supervision screen
4) The Coding and Sequence screen
5) The PCM Diagnostics screen

3-14.2.1 KEY OPERATION IN PRIMARY OPTION SCREEN

The example display for the Primary Option Screen in Section 3-14.2 is repeated below:



The functions of the various front panel keys within this screen are:

The Up/Down Arrows increment and decrement the PCM Channel Number from 1 to 24.

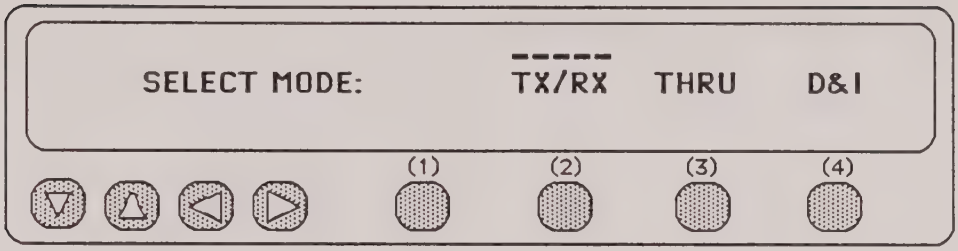
The Right Arrow key advances to the Supervision Lamp display and so on.

The Left Arrow key brings up the PCM Diagnostics display and so on.

Numeric input is treated as a Channel Number. Any number between 1 and 24 may be entered.

Softkey 1 toggles between SEND-1 and SEND-2 if the 930A is in the THRU or D&I mode. In the TX/RX mode, the Send direction is always SEND-1 and Softkey 1 is inactive.

Softkey 2 selects the basic PCM mode. Pressing it brings up the following display:



Pressing Softkeys 2, 3, or 4 will then select either the TX/RX, THRU, or D&I mode, respectively, and return to the primary screen. Refer to Section 3-14.3 for details on the use of TX/RX, THRU, and D&I.

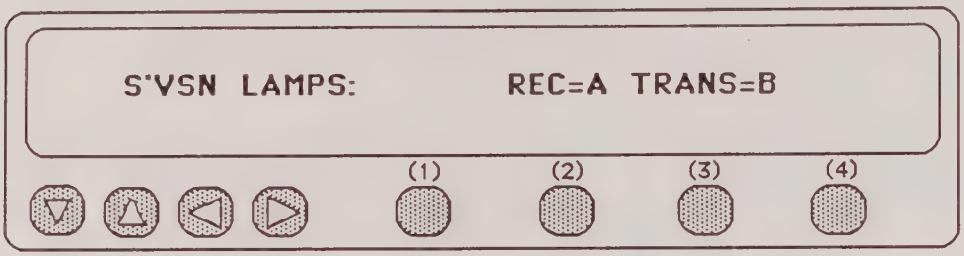
Softkey 3 toggles between TERM (100 ohms PCM input) and BRIDGE (>1000 ohms impedance).

Softkey 4 toggles between Internal (INT) clock (derived from the 930A internal crystal oscillator) and External (EXT) clock (derived from the PCM input bit stream). In THRU and D&I modes, External clock is always selected.

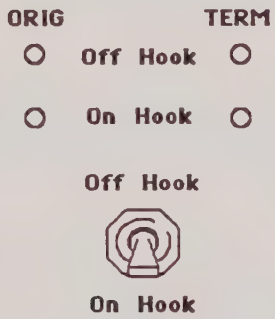
Pressing the Right Arrow key will advance to the Supervision Lamp option screen which is discussed in the next sub-section.

3-14.2.2 KEY OPERATION IN THE SUPERVISION LAMP SCREEN

A Supervision Lamp option screen may typically appear like the following example:



Since there are two supervision bits in PCM, the Supervision Lamps (located above the Hook Switch) may be set to follow the A or B bit as appropriate.

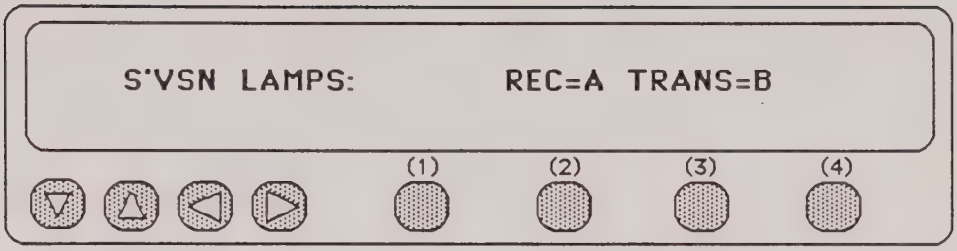


If it is desired to control the A and B bits independently, or to see the status of both bits simultaneously, refer to Section 3-14.5 OPTION NUMBER: 21 TOGGLE A/B BITS.

The front panel key operation within the Supervision Lamp screen is as follows:

The Left Arrow key returns to the Primary Option screen.

The Right Arrow key advances to the Transmit Supervision screen.



Softkeys 1 and 4 are inactive.

Softkey 2 toggles the receive supervision lamp to follow the A or B bit.

Softkey 3 toggles the transmit supervision lamp to follow the A or B bit.

NOTE: The "TERM" lamp follows received supervision, and the "ORIG" lamp follows transmitted supervision, except in Receive Records.

In THRU mode, supervision sense (Originate vs. Terminate) is dependant upon the direction selected.

In SEND-1, The "ORIG" lamp follows supervision on PCM-1 IN and the "TERM" lamp follows supervision on PCM-2 IN.

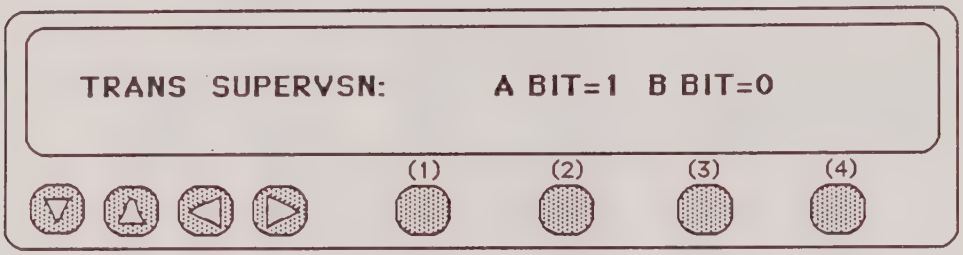
In SEND-2, The "ORIG" lamp follows supervision on PCM-2 IN and the "TERM" lamp follows supervision on PCM-1 IN.

In Receive Records, this is reversed.

Pressing the Right Arrow key advances to the Transmit Supervision option screen which is discussed in the following sub-section.

3-14.2.3 KEY OPERATION IN THE TRANSMIT SUPERVISION SCREEN

An example of a Transmit Supervision option screen is shown below:



This screen allows the user to set the A and B bits which the 930A will send. They can be set independently to 0 or 1, or they can be set to follow the Hook Switch (On Hook=0 , Off Hook=1). The functions of the front panel keys within the Transmit Supervision screen are as follows:

The Left Arrow key returns to the Supervision Lamp screen.

The Right Arrow key advances to the Coding and Sequence option screen.

Softkeys 1 and 4 are inactive.

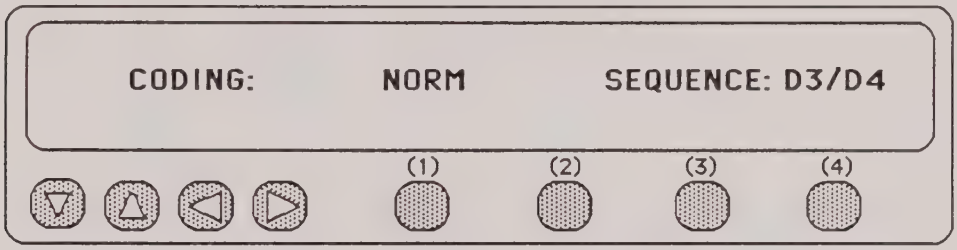
Softkey 2 is a wheel which allows the user to set the A bit to 0, to 1, or to follow the Hook Switch.

Softkey 3 is a wheel which allows the user to set the B bit to 0, to 1, or to follow the Hook Switch.

Pressing the Right Arrow key will advance to the Coding and Sequence option screen discussed in the next sub-section.

3-14.2.4 KEY OPERATION IN THE CODING AND SEQUENCE SCREEN

This option screen allows the user to select either Normal (Robbed Bit or 7-5/6 bit signaling) or CCIS (all 8 bits in every frame are used for data and signaling is carried over a separate path out of band) encoding, and to set the proper channel numbering sequence (D1D, D2, or D3/D4). A typical display is shown below:



The functions of the front panel keys within this option screen are as follows:

The Left Arrow key returns to the Transmit Supervision screen.

The Right Arrow key advances to the PCM Diagnostics screen.

Softkey 1 selects either Normal or CCIS signaling.

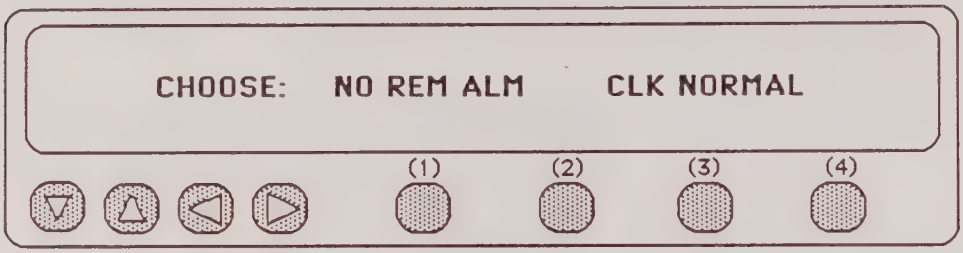
Softkeys 2 and 3 are inactive.

Softkey 4 is a wheel and allows the user to select either D1D, D2, or D3/D4 channel numbering.

Pressing the Right Arrow key will advance to the PCM Diagnostics option screen which is described in the next sub-section.

3-14.2.5 KEY OPERATION IN THE PCM DIAGNOSTICS SCREEN

This option screen allows the user to send Remote Alarm (Yellow Alarm) or to skew the 930A's internal clock by 100 Hz to facilitate Slip detection. A typical display of this screen is shown below:



The operation of the front panel keys within the PCM Diagnostics option screen are as follows:

The Left Arrow key returns to the Coding and Sequence screen.

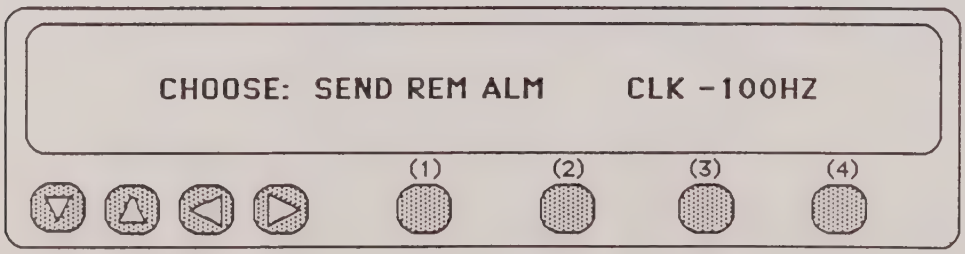
The Right Arrow key brings back the Primary Option screen.

Softkey 1 toggles between SEND REMOTE ALARM and NO REMOTE ALARM.

Softkeys 2 and 4 are inactive.

Softkey 3 toggles between normal clock (1.544 MHz) and skewed clock (1.5439 MHz).

If Softkeys 1 and 3 had both been pressed, the display would be:



Remote Alarm (Yellow Alarm) is the condition where bit number 2 in all 24 time slots is forced to zero (low) in every frame. At the far end this alarm condition causes the channel bank to go OFF HOOK and essentially busy itself out to prevent usage of that trunk group. The Model 930A can send Remote Alarm only in the TX/RX mode when it originates all 24 channels.

Slips are said to occur when the transmit and receive PCM bit streams in a given span are not synchronous with each other. In a synchronous system such as T-1, this condition may arise from the situation where both ends of the circuit are attempting to provide clock. In a synchronous system there can only be one master clock and all other equipment in the system derives its timing from the master clock source. In some instances, notably during maintenance, a channel bank or multiplexer may be switched to its own internal clock and taken out of the loop timed (derived clock) mode. At the end of the maintenance, if the channel bank is not returned to loop timing, then the two opposing clocks fight each other and slips occur. This often takes a while to show up, since the clocks are usually close in frequency and relatively stable, so slips are rare. Skewing, or off-setting, the clock at one end of the circuit will quickly show this condition by causing frequent slips. If the circuit is correctly set up with only one end supplying clock, then the frequency offset will have no effect and no slips will be produced.

3-14.2.6 PCM ERROR MESSAGES

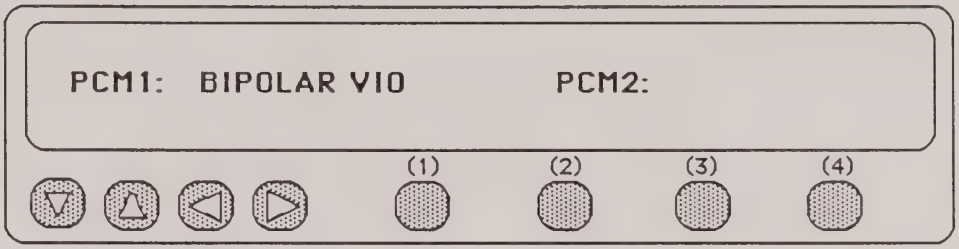
If an error or abnormal condition on the PCM span is detected, the 930A will produce an audible beep, clear the screen, and briefly display the error message. The errors are displayed in a hierarchial manner. That is, if NO PCM is detected, the 930A will report it, but not a FRAME LOSS. Similarly, FRAME LOSS takes precedence over a FRAME ERROR or BIPOLAR VIOLATION. The 930A DS-1 PCM Error Messages, in hierarchial order, are:

1) NO PCM! --No incoming PCM bit stream has been detected.
2) FRAME LOSS -- Frame synchronization cannot be acquired or has been lost.
3) FRAME ERR -- An error has been detected in a Frame bit.
4) SLIP -- The incoming and outgoing bit streams have lost clock synch.
5) BIPOLAR VIO -- Two consecutive pulses of the same polarity appear on the span line which is a violation of the Alternate Mark Inversion (AMI) line code format.
6) REMOTE ALARM -- The far end of the circuit is in an alarm condition.

NOTE: A "Red Alarm" is generally signaled if either a "NO PCM !" or a continuous "FRAME LOSS" error message occurs. A "Yellow Alarm" corresponds to the REMOTE ALARM condition. For a precise description of "Red Alarm", refer to AT&T Publication 43801.

If two or more errors are detected on the same PCM bit stream, only the highest priority error will be displayed. The Model 930A, however, has the capability to look at two PCM bit streams simultaneously if Option 09 has been installed. In this case errors which occur are labeled according to the PCM board which detects them (With Opt. 09 there are two PCM boards-one for each direction).

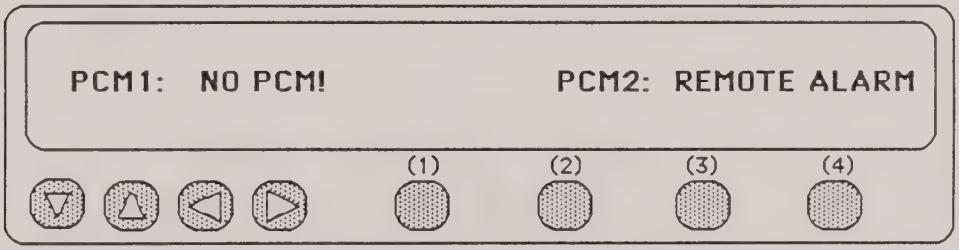
An example of an error message under these conditions could be:



This indicates that a Bipolar Violation was detected on board 1 but no errors were detected on board 2. Note that, in the case of Option 8, there is no board 2 and so PCM errors are only detected in one direction at a time.

Another example of an error message with the dual direction option installed follows:

With the 930A in the THRU mode, the output of the originating end is disconnected. The terminating end receives no PCM and sends back the Remote Alarm. The error message, with the 930A in SEND-1, appears as:



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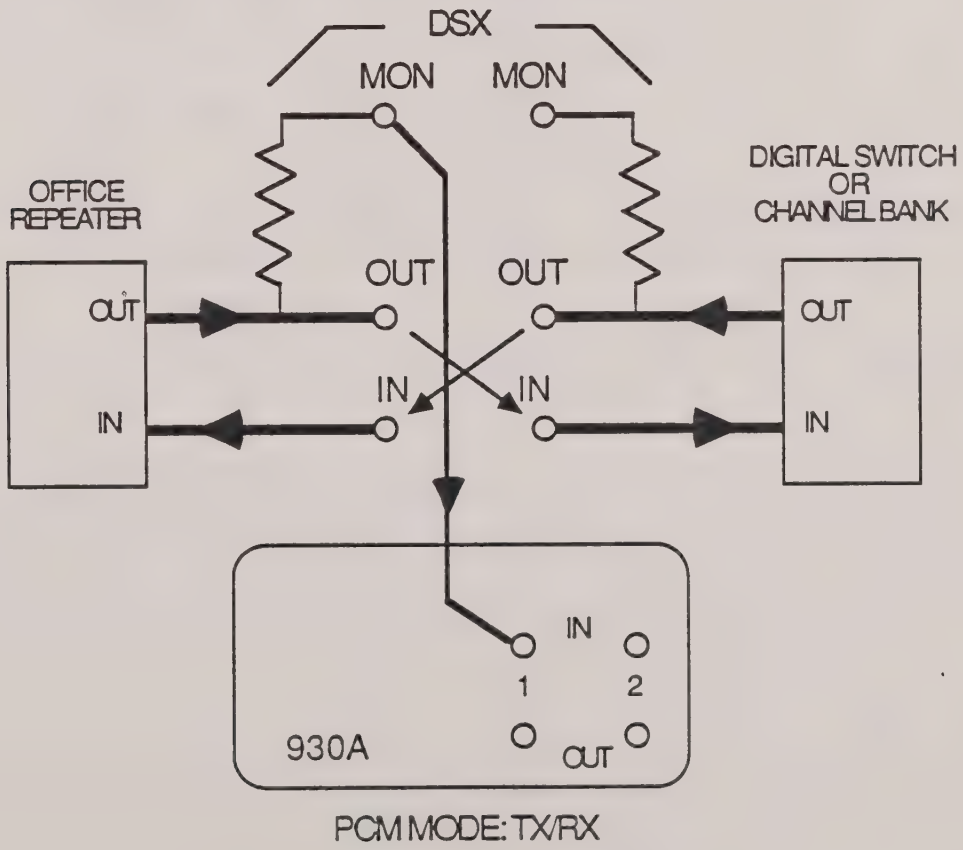
3-14.3 PCM TRUNK TESTING USING THE 930A

In most cases the 930A will be connected to the PCM span lines at what is referred to as the DSX. The Digital Signal Cross-Connect (DSX) is merely a large jackfield which consists of either the older Western Electric Type 310 jacks or the newer tiny telephone or bantam jacks. In the telephone central office environment, all DS-1 digital equipments interface with each other at the DSX. There are no hard-wired or direct connections between equipment. This is for test access as well as to provide a demarcation point for record keeping.

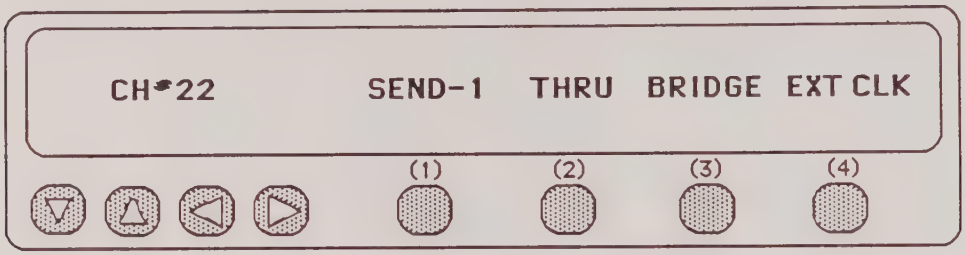
The following paragraphs and figures describe some of the ways in which a 930A may be connected to the DSX for testing. The 930A display screens will vary depending upon what tests are being performed. In order to correctly set up the instrument, refer to these figures to decide the correct mode of operation for the testing desired. The most basic test mode is Monitor Only, as shown in Figure 3-3 below:



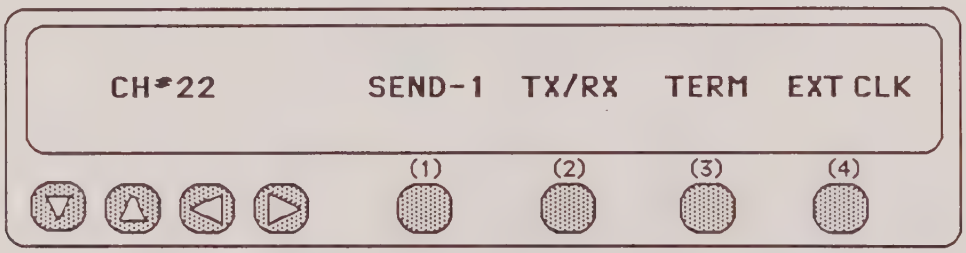
PCM MODE: TX/RX

MONITORING A PCM SPAN LINE
FIGURE 3-3

All PCM testing with the 930A is initiated from the Primary PCM Option Menu. An example of this menu is shown below:



When connected to the Monitor jack of a DSX, the 930A should be set to TX/RX mode by pressing Softkey 2. The 930A must also be placed in the TERM mode by pressing Softkey 3 and should be deriving clock from the line being monitored. Press Softkey 4 to select External (EXT) clock if EXT is not already displayed. The correct 930A display will look somewhat like:



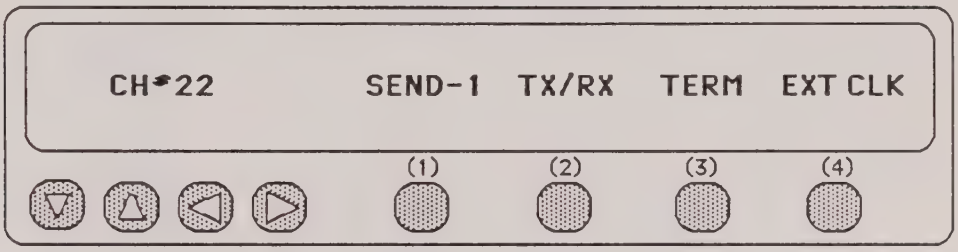
The display over Softkey 1 is automatically set to SEND-1 in the TX/RX mode.

Connecting the 930A as shown in Figure 3-3 above enables the user to monitor any of the 24 trunks on a span line coming in through an office repeater. In this example, the test set is connected to only one direction of transmission and can only receive VF signals and supervision from that direction. Once the desired timeslot has been selected with the 930A, any of the test set's receive functions may be used.

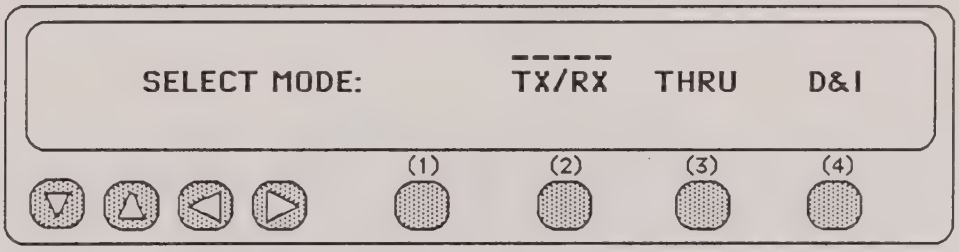
The Monitor mode is very useful for testing in-service trunks because it does not disturb the traffic or cause hits on the span line. To look at the transmission from the other direction it would be necessary to plug the test set into the Monitor jack coming from that direction.

This is the so-called "Half-Channel" measurement technique which earlier PCM Access test sets employed because they had only one receiver and one transmitter. The 930A equipped with Option 08 would be used in this manner.

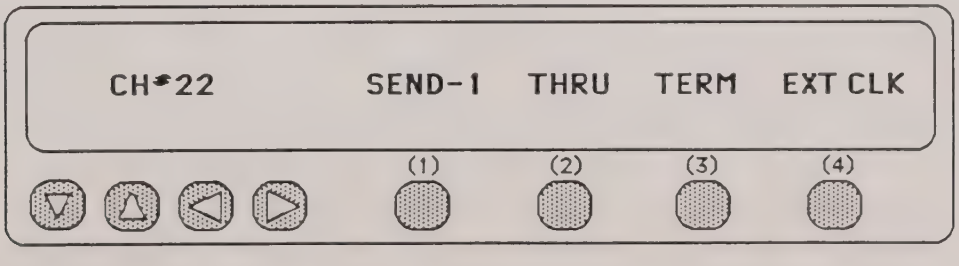
However, the 930A equipped with Option 09 enables the user to Monitor both directions of transmission on a span line. Such a connection is shown in Figure 3-4. Set-up is similar to that previously described for single direction monitoring except that THRU mode must be selected using Softkey 2 instead of the TX/RX mode. Using the display from the previous page:

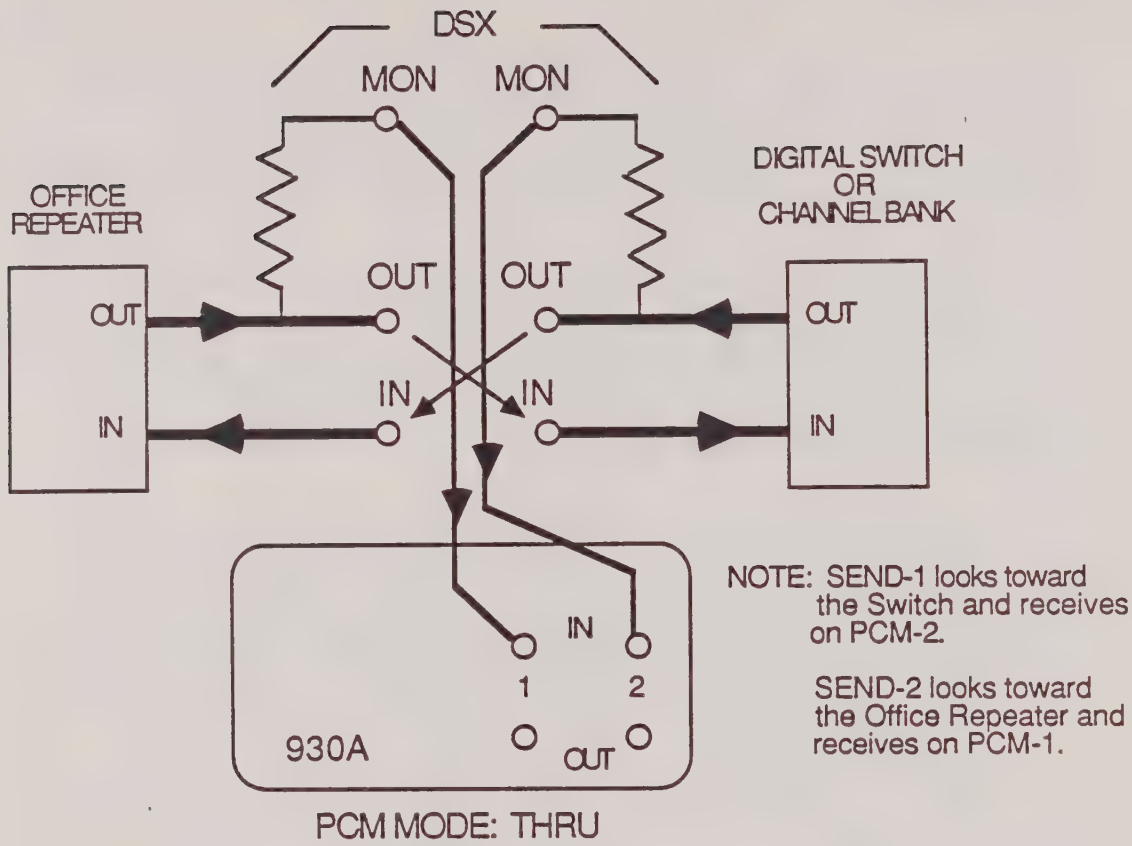


Pressing Softkey 2 will bring up the SELECT MODE display as shown below:



The highlight shows that TX/RX is the current mode and pressing Softkey 3 selects the THRU mode. The 930A display should then look somewhat like:





DUAL DIRECTION PCM MONITORING
FIGURE 3-4

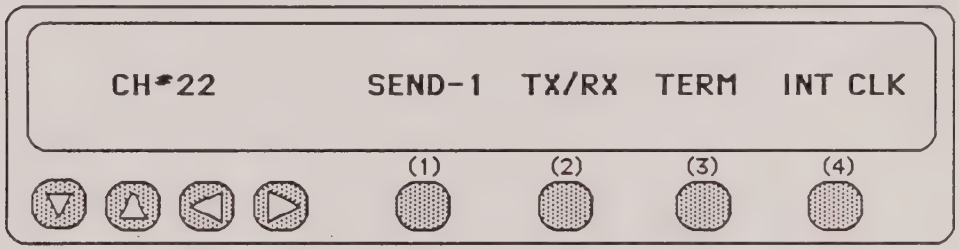
In the dual direction monitoring mode, the 930A displays trunk supervision for both directions of transmission. VF information on a selected channel is decoded for one transmission direction at a time.

In the THRU mode, unlike TX/RX, SEND-1 enables the user to monitor channels coming in on the PCM2 jack and SEND-2 monitors channels on the PCM1 jack. Selection between SEND-1 and SEND-2 is made by means of Softkey 1 and the user does not have to switch test cords around to look in either direction.

Supervision sense (Originate vs. Terminate) is dependent upon the direction selected. Refer back to Section 3-14.2.2 for details.

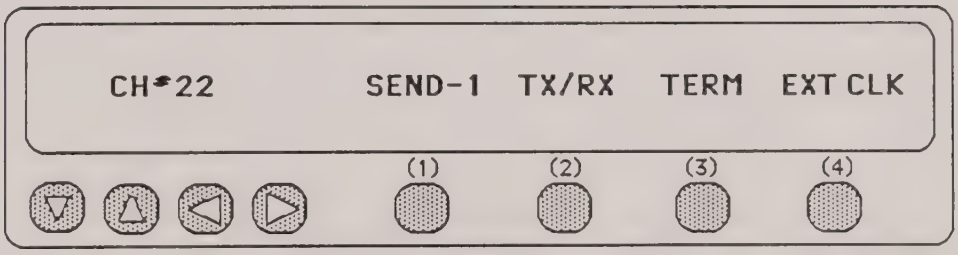
For testing trunks on out-of-service span lines (pre-cutover or turned down for maintenance), the 930A can generate, as well as receive, a DS-1 signal. In this type of application, the 930A would be connected as shown in Figure 3-5.

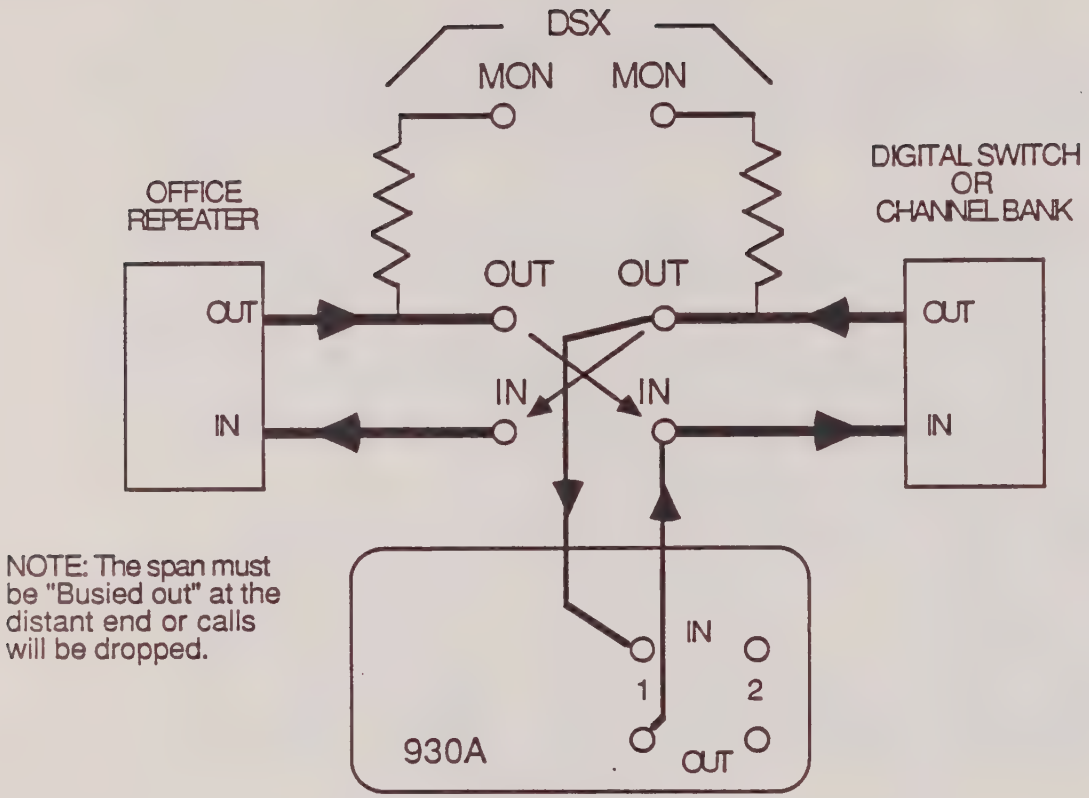
The Model 930A (with PCM Trunk Type selected) would then be placed in the TX/RX mode by pressing Softkey 2. The user would set the clock source to either internal (INT) or external (EXT) as appropriate by pressing Softkey 4 as needed. If the 930A is being used to simulate the Telephone Central Office end of a circuit or in any application where it is simulating equipment that is supplying the timing, then the 930A should be set to INT. The 930A PCM display would look somewhat like:



This enables the equipment to which the 930A is connected to operate in the "Loop Timed" mode.

If the 930A is being used to simulate the channel bank or customer premises end of a circuit, then it will usually be set in the EXT timing mode since the equipment under test will normally be supplying the clock. The display in that case will appear somewhat like:





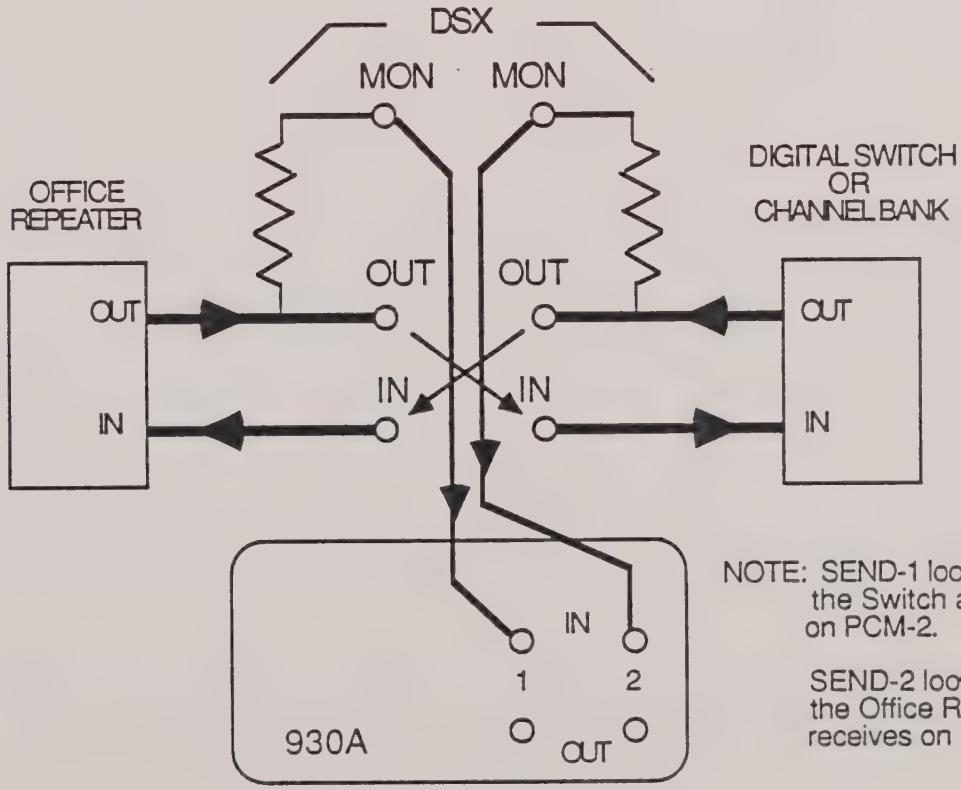
PCM MODE: TX/RX

TX/RX TO A DIGITAL SWITCH
FIGURE 3-5

Trunk transmission and signaling can be tested completely before the trunk is placed in service using the TX/RX mode to simulate either end of a circuit. In the above example, the 930A was placed in EXT clock mode to simulate the loop side of the circuit. To test toward the loop (simulate the Switch) simply set the 930A to INT clock mode and transfer the test cords to the DSX jacks looking out toward the Office Repeater.

If it is necessary to send a signal over one of the 24 channels (trunks) on a span line when the trunks are in-service, the 930A should be used in the Drop and Insert mode. This requires that Option 09 (Dual Direction Drop and Insert) be installed in the 930A. In this mode of operation, the DS-1 span line signal is fed through the test set which is, in effect, in series in the line. When the 930A is placed in the Drop and Insert mode, the VF signals and supervision coming in on the selected channel are "Dropped" by the set and in their place the 930A "Inserts" its own VF signal and supervision information. The other 23 channels pass through the test set unaffected. The question arises, "How do we place the test set in series with the line without dropping the entire system"? The answer is that connecting the test set for Drop and Insert must be a two step procedure and these steps are shown in Figures 3-6 and 3-7.

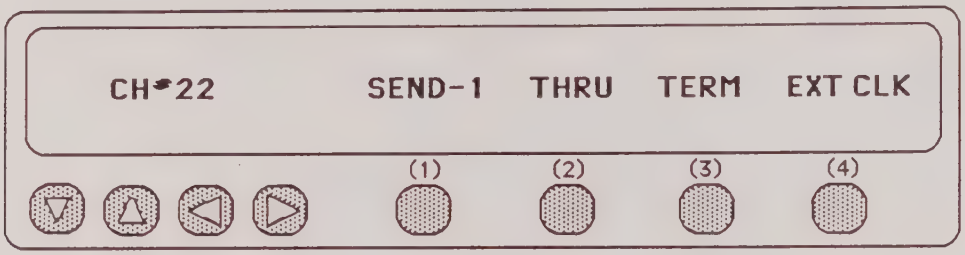
First, the 930A should be set to the THRU mode by pressing Softkey 2 in the same manner previously described. Next, the 930A should be connected to the DSX as shown in Figure 3-6.



PCM MODE: THRU

PREPARATION FOR DUAL DIRECTION DROP AND INSERT
FIGURE 3-6

Note that Figure 3-6 shows the same connection as previously employed for dual direction monitoring and the 930A display is somewhat like:



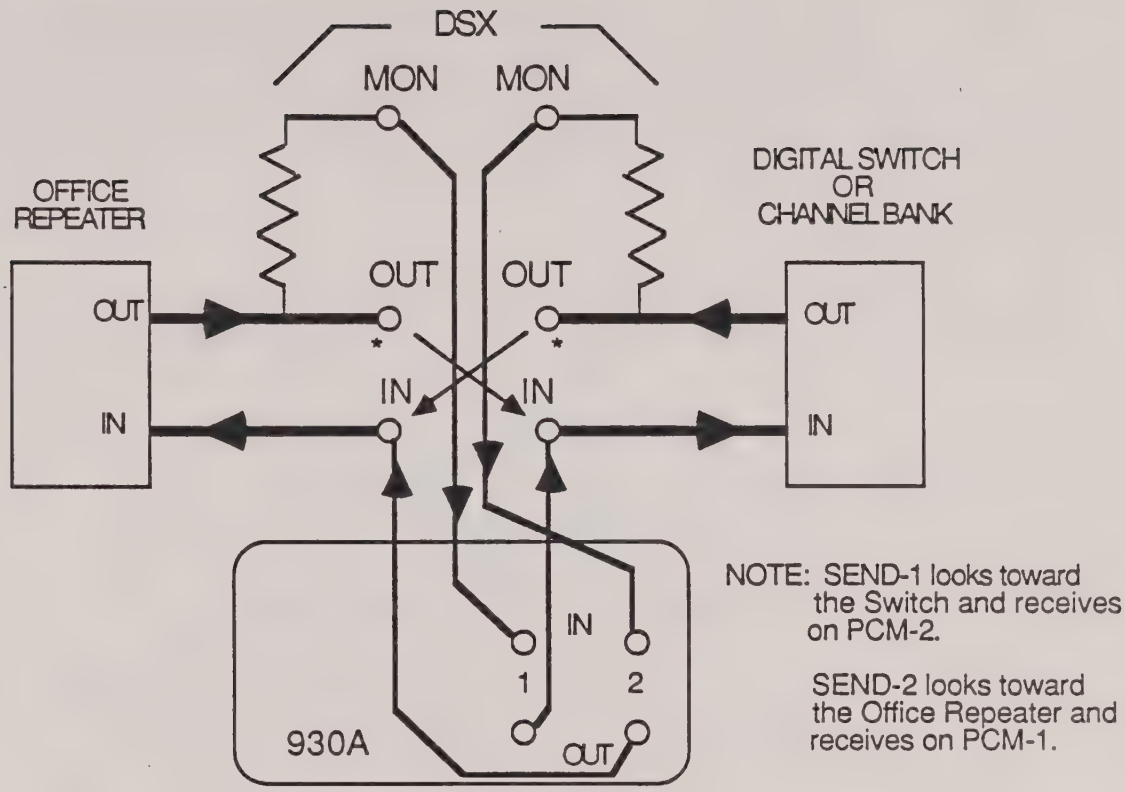
This is the first step and, once the set has been connected in this manner and is satisfactorily receiving PCM from both directions, the user may proceed to the second step.

The user should first plug test cords into the two PCM OUT jacks on the 930A before going on.

The second step consists of plugging the two OUTPUT test cords from the 930A into the appropriate DSX "IN" jacks as shown in Figure 3-7. To avoid unterminating the span line it is good practice to insert 100 ohm terminating plugs in the DSX "OUT" jacks of the system under test.

It is important to note that, while in the Drop and insert mode, the Model 930A purposely does not allow the operator to scroll through the PCM channels in a terminated mode. This avoids bringing down the span and causing alarms. The Model 930A instantaneously switches itself to the "THRU" mode as the operator starts to change channels. The operator may then go to the desired channel and monitor it without disturbing the system. If it is desired to actually test the new channel in the Drop and Insert mode, the operator must then select the D&I mode by pressing Softkey 2 and then choosing D&I from the resulting menu. This procedure prevents the operator from inadvertently causing hits on any of the other PCM channels not under test.

As an added indication, the 930A will "Beep" to alert the user to the change in mode from D&I to THRU.

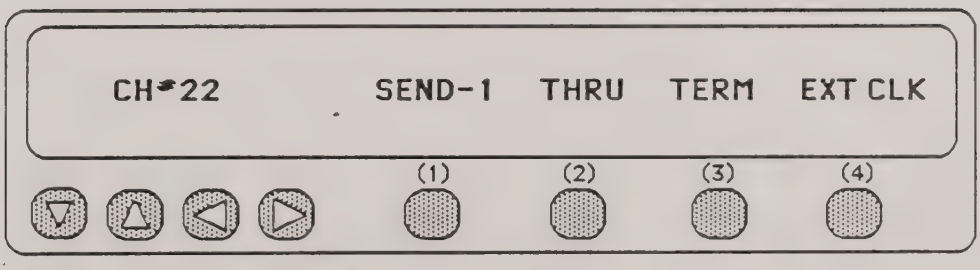


PCM MODE: THRU OR D&I

(* 100 ohm Termination Plug may be required)

DUAL DROP AND INSERT
FIGURE 3-7

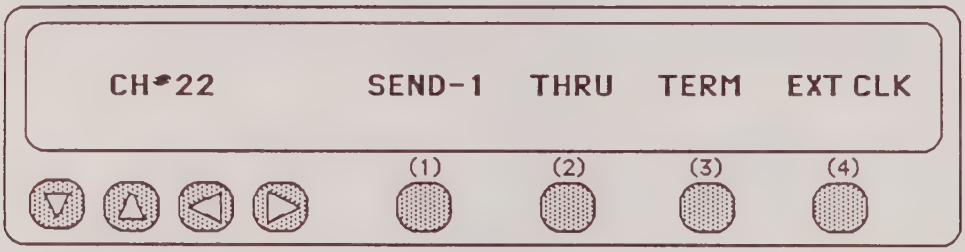
The previous 930A display is repeated below:



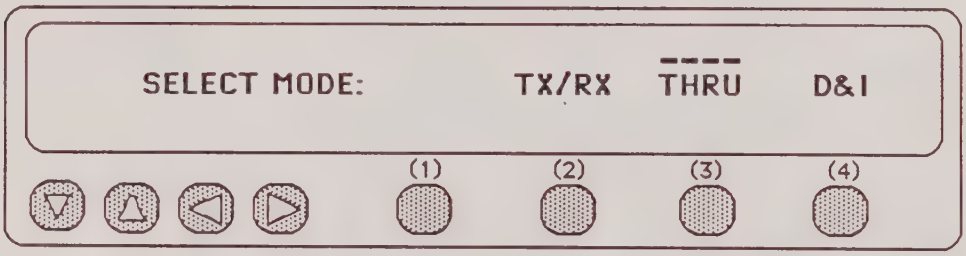
Pressing Softkey 1 on the 930A allows the user to test either toward the Office Repeater or toward the Digital Switch by selecting SEND-1 or SEND-2. The user may switch direction at will by pressing Softkey 1.

To avoid interfering with operating trunks on the span line it is good practice to Monitor the channels in the THRU mode before switching to the Drop and Insert mode. This can be accomplished easily by pressing Softkey 2 and switching between THRU and D&I modes. The 930A displays under these conditions appear as follows:

IN THE "THRU" MODE:

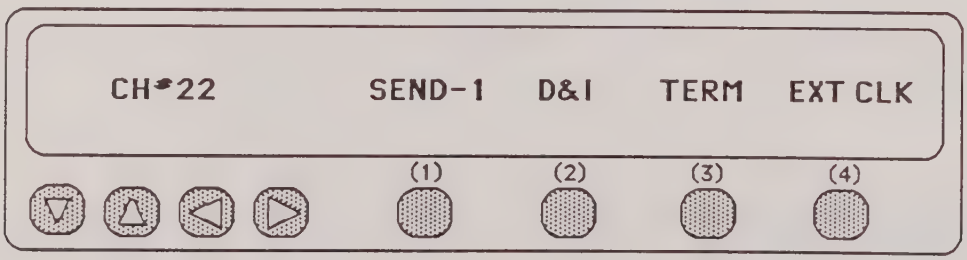


Pressing Softkey 2 would bring up the following display:



The highlight over THRU indicates that it is the currently selected mode.

To select Drop and Insert, simply press Softkey 4 and the 930A will enter the D&I mode and the display will change to:



To change back to the THRU mode simply press Softkey 2 again and select THRU mode by pressing Softkey 3 in the SELECT MODE menu. Note that in the THRU mode, all 24 channels pass through the test set undisturbed.

3-14.4 OPTION NUMBER: 20 24 BIT DISPLAY

When either PCM option has been installed in the 930A, additional menu options become available under the OPTION MENU Function key. Menu Option number 20 enables the user to look at the supervision bits on all 24 channels simultaneously.

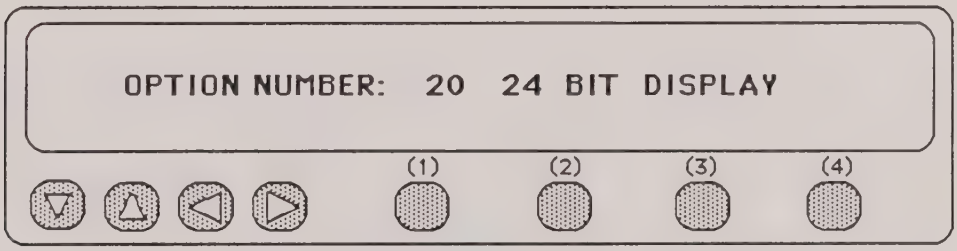
To use the 24 bit Display function, once the PCM trunk type has been selected, perform the following steps:

Press the Option Menu Option Menu key.

Use the UP/DOWN arrow keys

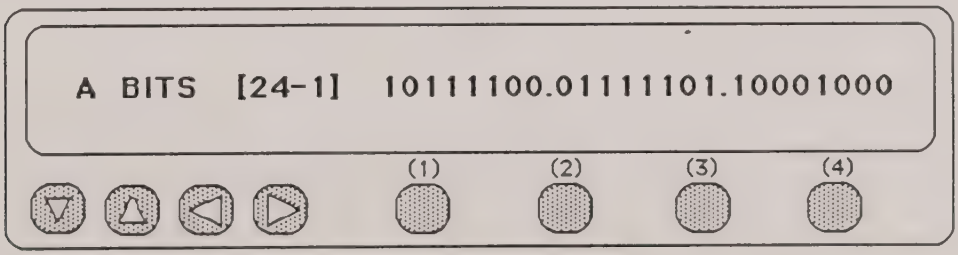
to select Menu Option 20, 24 BIT DISPLAY.

The 930A display will appear as:

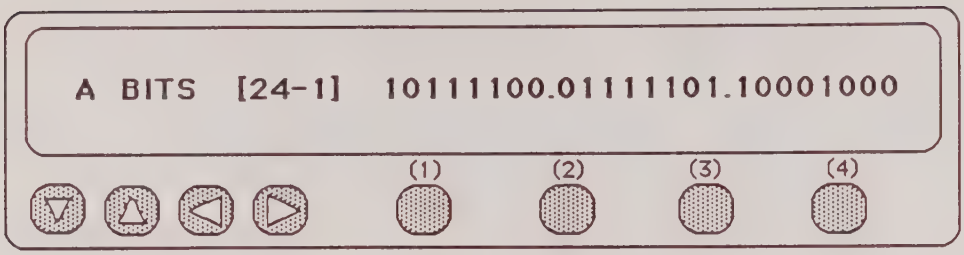


Press any Softkey to enter the menu option.

Once inside the option, the 930A display will look somewhat like the following example:



where "10111100.01111101.10001000" represents a typical 24 bit display of ones and zeroes, showing the supervision on all 24 channels.



The displayed digits are broken up into three groups of eight for easier reading. The channels are displayed in descending order, left to right, from channel 24 to channel 1. Softkey 1 allows the user to toggle between the A and B bit displays. The UP/DOWN arrow keys perform the same function.

This display is active whenever the 930A is receiving a PCM bit stream. In a Monitor mode this display makes an ideal activity monitor. With option 09 installed, the operator may use this menu option in the THRU and D&I modes also.

3-14.5 OPTION NUMBER: 21 TOGGLE A/B BITS

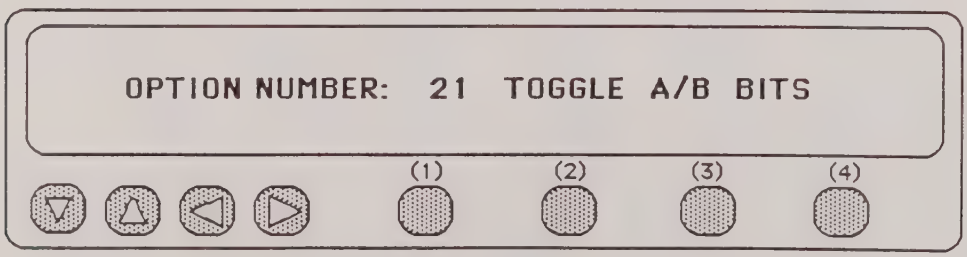
Another menu option available when either PCM option has been installed is Menu Option 21: TOGGLE A/B BITS. This menu option enables the user to change the state of the transmitted supervision bits from one to zero or vice versa. To use this menu option, first perform the following steps:

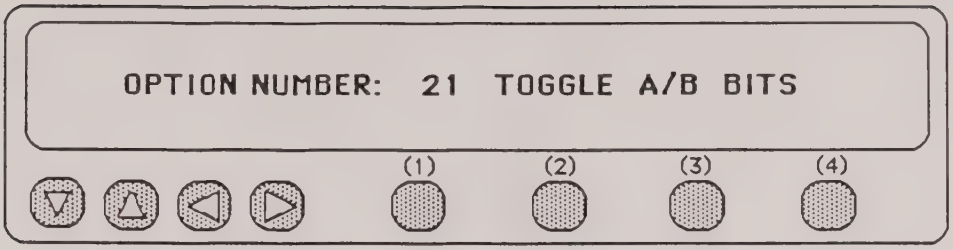
Press the Option Menu O **Option Menu** key.

Use the UP/DOWN arrow keys

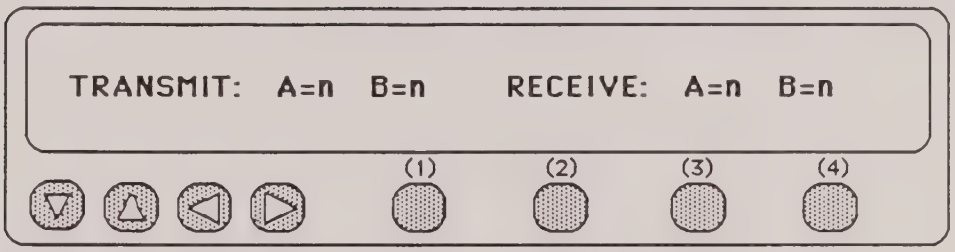
to select Menu Option 21, TOGGLE A/B BITS

The 930A display will be as shown below:





Once at option number 21, press any Softkey to enter, and the 930A display will appear as:



showing the Transmit and Receive supervision bits for the currently selected PCM channel. Each "n" will be equal to a zero or a one. Softkey 1 toggles the transmitted A bit between 0 and 1, and Softkey 2 toggles the transmitted B bit between 0 and 1. The Hook Switch is inactive and supervision is entirely under control of the Softkeys. Pressing any Function key will exit the option.

3-15 SF SUPERVISION OPTION

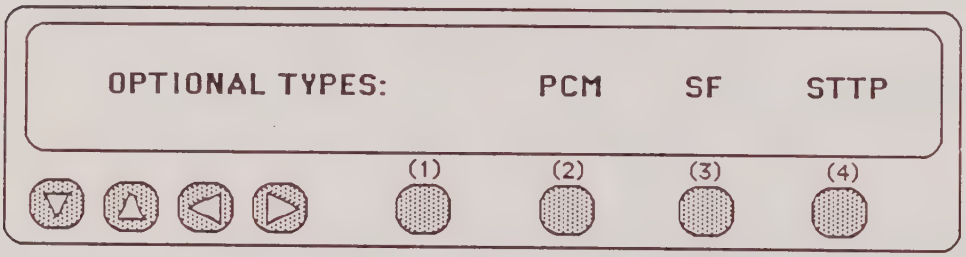
If Option 02: SF SUPERVISION has been installed in the Model 930A, then this optional trunk type can be accessed under the TRUNK TYPE key.

Press the Trunk Type Trunk Type Function key

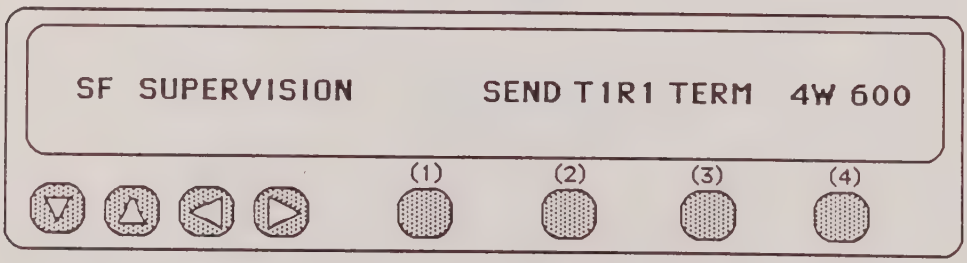
to display the currently selected Trunk Type.

Use the UP/DOWN arrow keys or

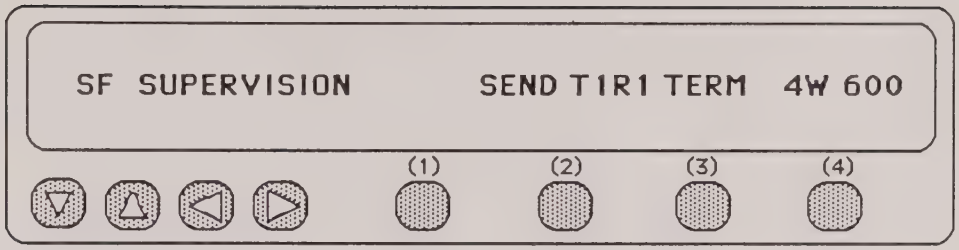
Softkey 1 to page through the available displays until the following display appears:



Press Softkey 3 to enter the SF supervision trunk type and the 930A display will look somewhat like the following:



Single Frequency (SF) supervision sends a 2600 Hz tone to indicate an On-Hook condition. It is inherently a 4-wire trunk type and is now mainly used on special service trunks in the U.S., having been largely displaced in the AT&T message network by CCIS signaling.



Within this display the operation of the front panel keys is as follows:

The Cursor keys and Numeric keypad are inactive.

Softkey 2 toggles the Send direction between TR and T1R1.

Softkey 3 toggles between BRIDGE (Monitor) and TERM (Simulate).

Softkey 4 is a wheel which allows the user to choose 150, 600, 900, or 1200 ohm transmit and receive impedances.

In practice, the impedance selected will most often be 600 ohms which is the typical 4-wire line impedance for analog transmission.

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3-16 3-LEVEL IMPULSE NOISE

This optional feature (Option 07), when installed in the Model 930A, provides a very important data transmission parameter measurement. The 3-Level Impulse Noise measurement is set up and operated from Menu Option 11. The following step-by-step instructions demonstrate the set-up and measurement procedure. Remember to set up the correct Trunk Type as outlined in Section 3-6 before proceeding.

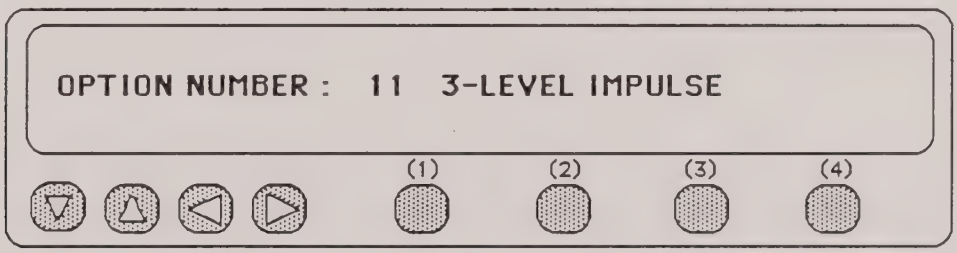
To begin:

Press the Option Menu **Option Menu** key.

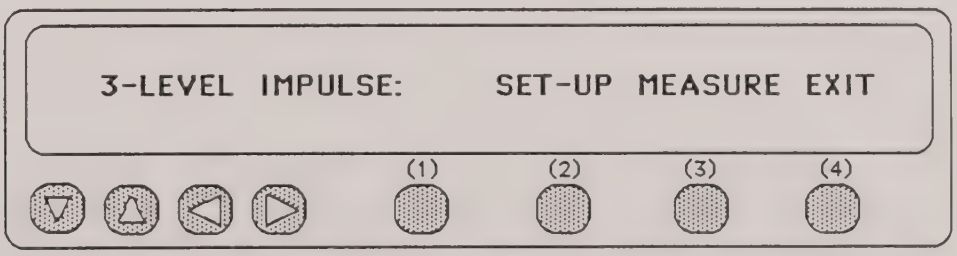
Use the UP/DOWN arrow keys

to select Menu Option 11, 3-LEVEL IMPULSE.

The Model 930A display will appear as:



Pressing any Softkey will enter the Menu Option and the display will then show the following:

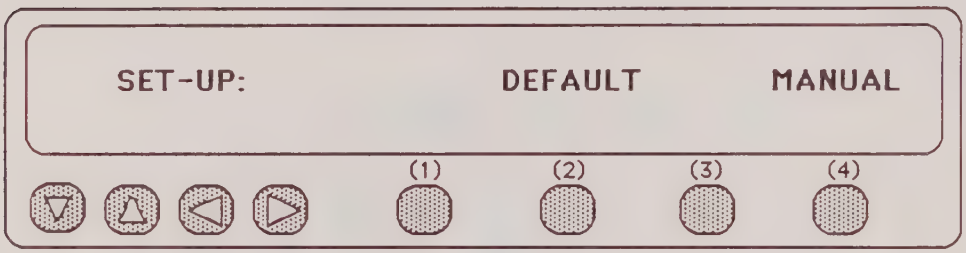


This display offers three choices: Set-up of the test parameters, Begin Measuring, or Exit from the menu option. If the user has previously set-up

the measurement parameters then it is possible to skip the set-up and proceed directly to measurment. However, for purposes of example, this step-by-step procedure will assume that the test parameters have not yet been set up.

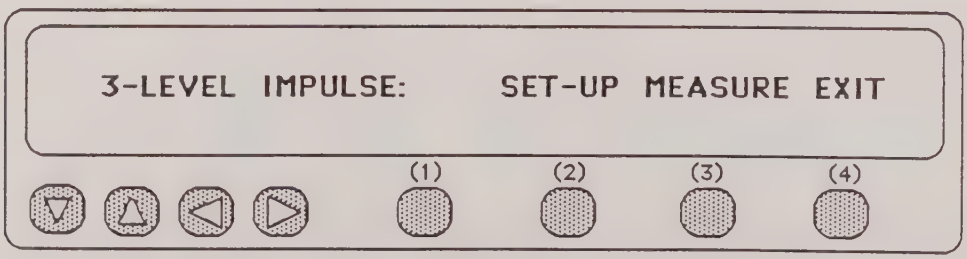
To continue:

Press Softkey 2, labeled "SET-UP", to enter the Set-Up display and the Model 930A will appear as follows:

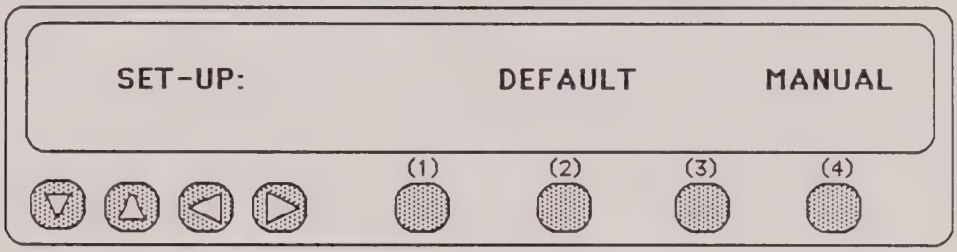


The above display enables the user to select either the default values of the 3-Level Impulse Noise measurement or manual entry of parameter values. The default values for Impulse Noise measurement are taken from AT&T published specifications for measurements on Voiceband Data circuits. Pressing Softkey 2 will cause a momentary display of these values which are shown below:

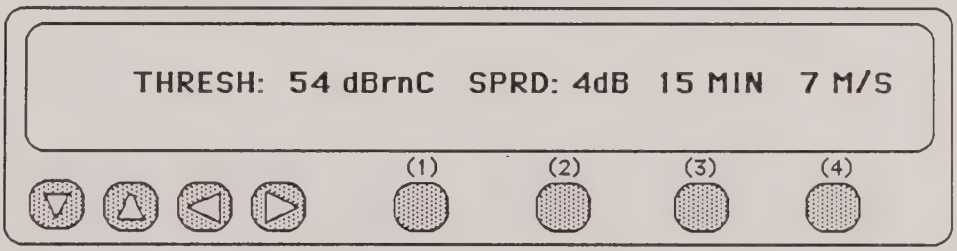
After a short time the Model 930A display will revert to:



If the default values of Threshold, Spread, Measurement Time, and Measurements per Second are to be used then the next step is to simply press Softkey 3. For example purposes however, assume that it is desired to manually enter other values for these parameters. Begin at the point where the 930A Set-Up display is shown:

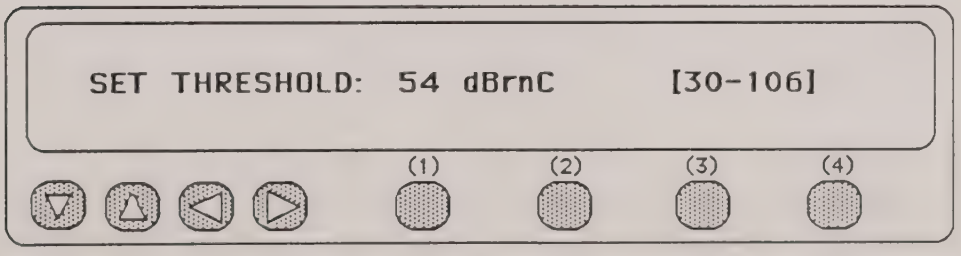


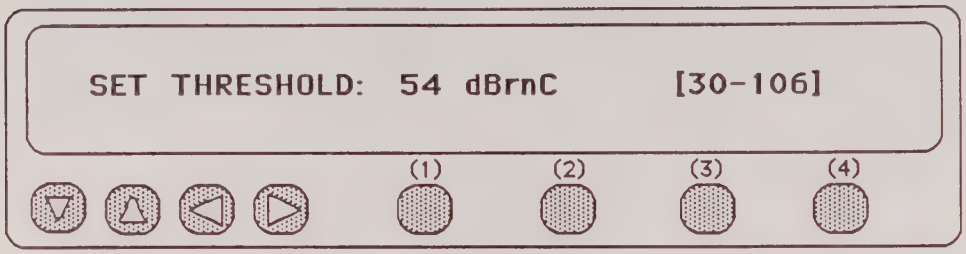
Instead of pressing Softkey 2 press Softkey 4 to enter the Manual Set-Up display which will appear as shown below:



Now, instead of appearing only momentarily, the display will remain. There are four parameters which can be changed from their default values. The user may change any or all of them by first selecting them with the appropriate Softkey. Suppose it is desired to change all of them beginning with the impulse noise threshold. To accomplish this perform the following steps:

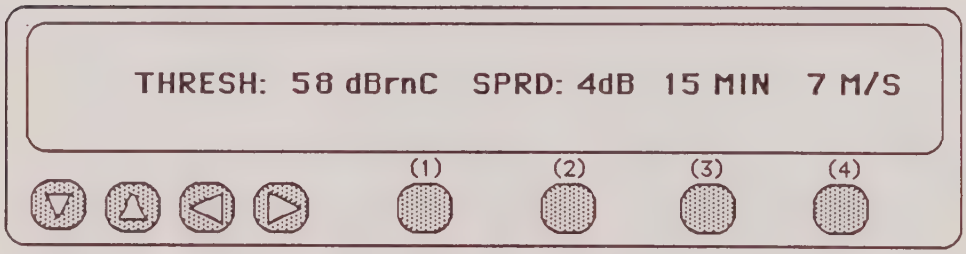
Press Softkey 1 and the 930A display will change to:



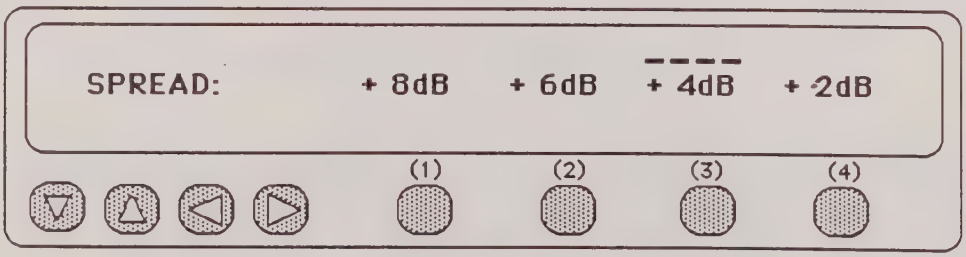


The range of threshold settings permitted is shown on the right side of the display and is 30 to 106 dBrnC. Suppose it is desired to have 58 dBrnC as the lower threshold. To change to this value perform the following steps:

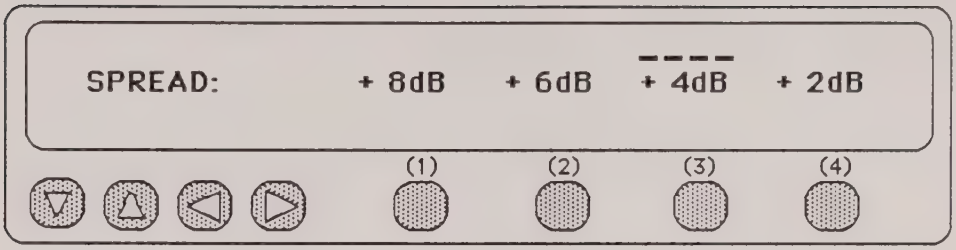
Press [5] then [8] and then [ENT]
and the 930A display will show:



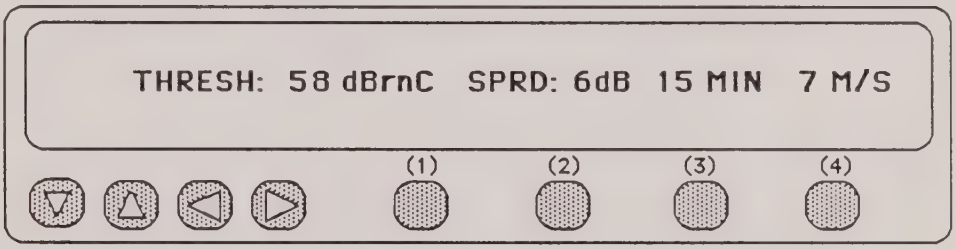
Note that the new threshold value is now displayed and the impulse noise counters are now set to 58 dBrnc, 62 dBrnc, and 66 dBrnC. Next, to change the size of the spread between the Low, Mid, and High impulse noise measurement counters, press Softkey 2 and the 930A display will change to:



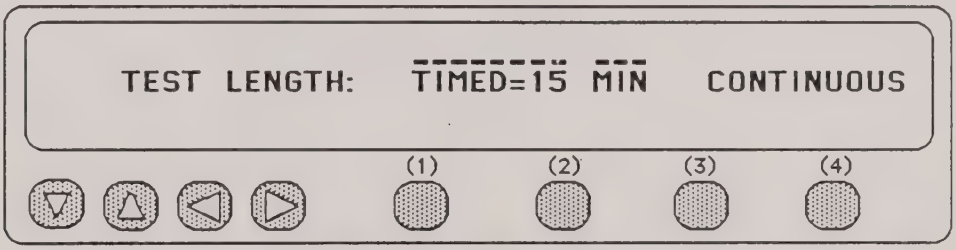
The flashing cursor appears over the currently selected step size (+4 dB in this example). The step size choices range from + 8 dB to + 2 dB in 2 dB increments and each choice appears directly above it's associated Softkey.



To choose, for example, a step size of + 6dB instead of the + 4 dB value, simply press Softkey 2 and the 930A display will change to:

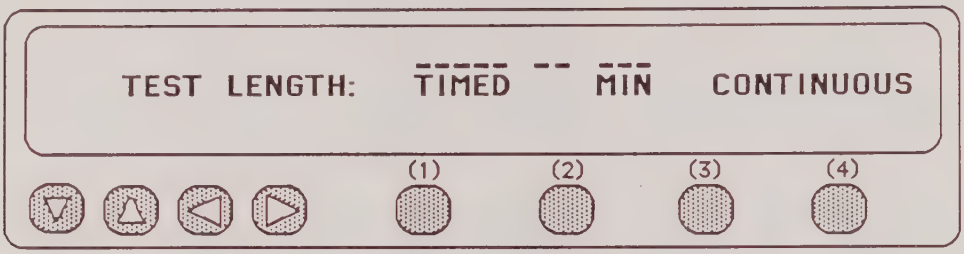


Note that the Spread is now 6dB and the counter thresholds will now be set at 58 dBrnC, 64 dBrnC, and 70 dBrnC. Next, to change the measurement time period, press Softkey 3 and the 930A display will show:

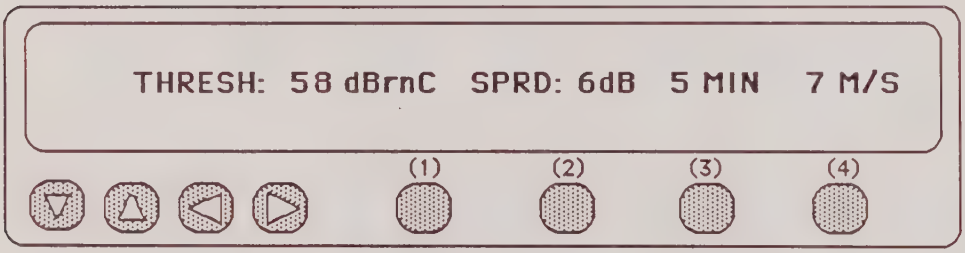


The Model 930A can make timed measurements of impulse noise from 1 minute duration to 99 minutes duration or it can be set to continuously measure. Softkey 2 controls the timed measurement and Softkey 4 selects continuous measurement.

Suppose for this example that a 5 minute test length is desired. Press Softkey 2 and the 930A display becomes:

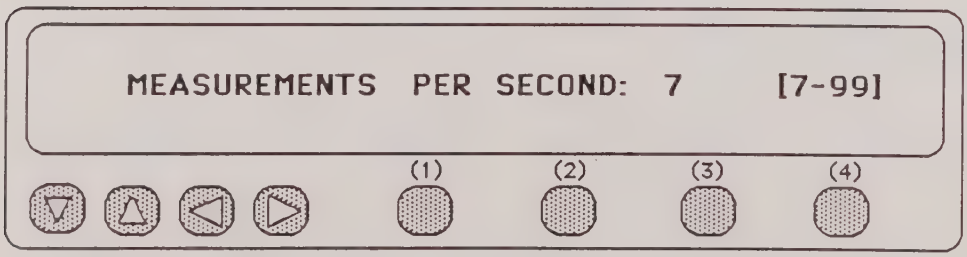


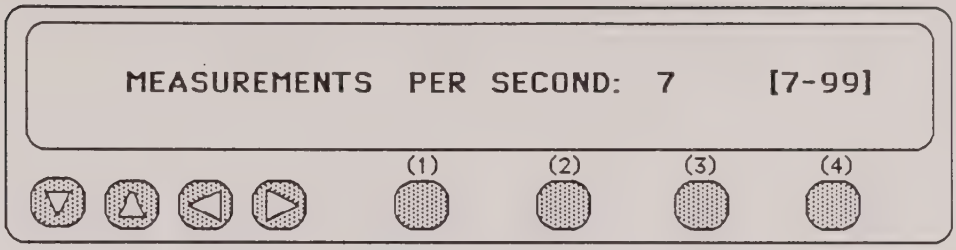
Press [5] and then [ENT]
and the 930A display changes to:



Having now changed the measurement time length, the final step is to change the number of measurements the instrument makes per second. The standard value is 7 measurements per second but other common values are 8 measurements per second and what is called a "channel limited" measurement. To change the number of measurements per second, do the following:

Press Softkey 4 and the 930A
display will change to:

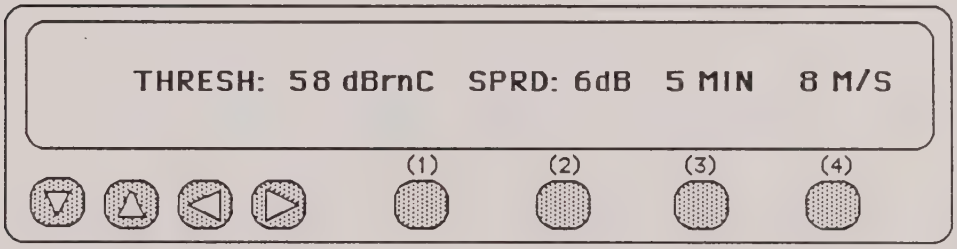




Note that the acceptable values range from 7 measurements per second to 99 measurements per second. If, for example, it is desired to set in a value of 8 measurements per second, then do the following:

Press [8] and then [ENT]

and the 930A display will change to:

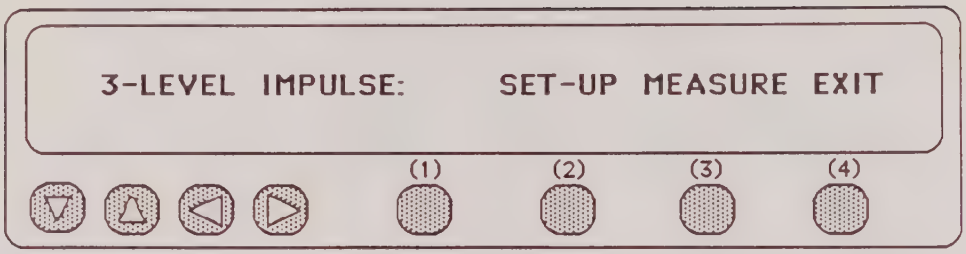


All of the Impulse Noise measurement parameters have now been changed. The user is free to select other values within the acceptable ranges given for each parameter.

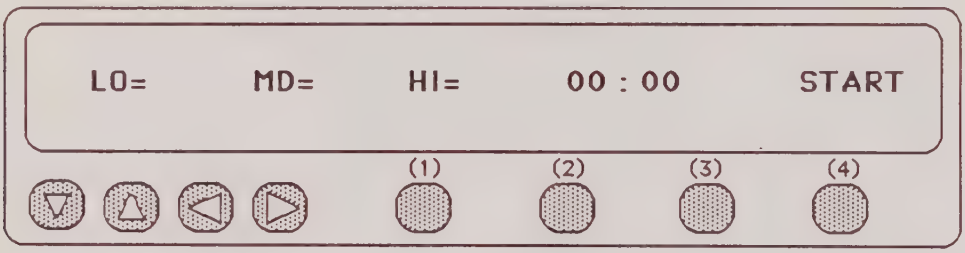
Once the user has set-up the Model 930A, the next step is to get back to the 3-LEVEL IMPULSE display so that measurements can be started. If the DEFAULT values had been chosen the 930A would have momentarily displayed them and then returned to the 3-LEVEL IMPULSE display. However, this example has assumed that MANUAL was selected and so the following must be done to return to the desired display:

Press the Option Menu Option Menu key.

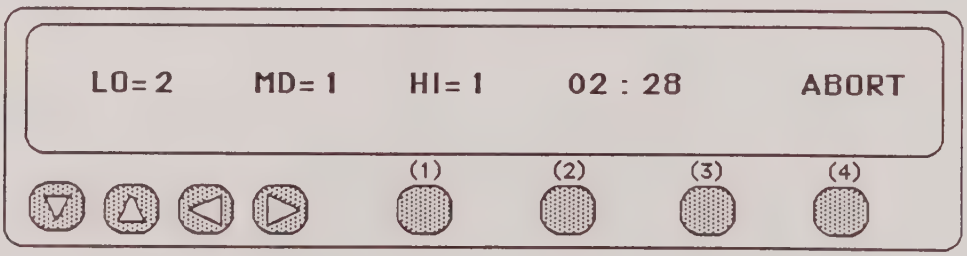
The 930A display will change to:



In order to begin making measurements the user must now press Softkey 3 which will bring up the main Impulse Noise measurement display as follows:



To start testing press Softkey 4 and the 930A will start making measurements. After some time has elapsed (remember that this example has set a 5 minute measurement time) a typical display might appear as:



This display shows that after 2 minutes and 28 seconds of testing, there have been 2 impulse noise bursts that have exceeded the 58 dBrnC threshold, and 1 each that have exceeded the 64 dBrnC and 70 dBrnC thresholds. This test would continue until 5 minutes had elapsed and would then stop using the parameters which had been manually input in this example. The user may choose to Abort the test at any time by pressing Softkey 4 (labeled ABORT while the test is running).

SECTION IV
REMOTE CONTROL OPERATION

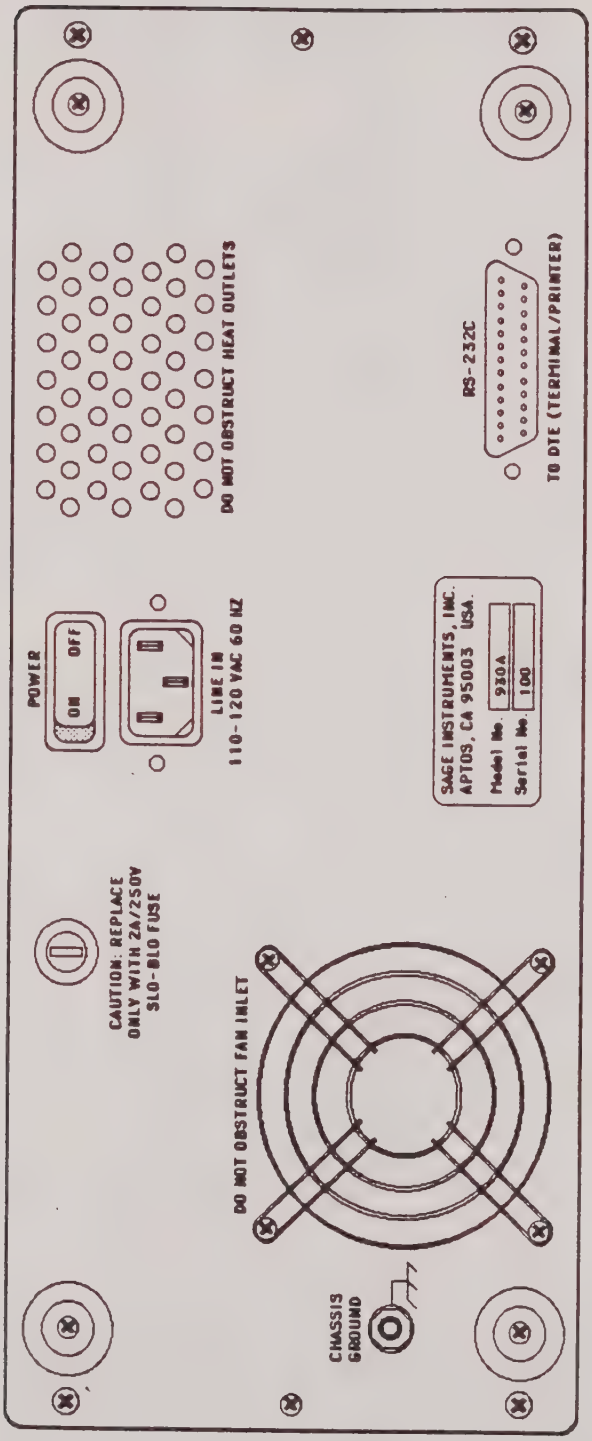
4-1 INTRODUCTION

The Model 930A, when equipped with Option 10, may be remotely controlled, or may itself control a printer, through an RS-232C serial port located on the rear panel. The connector is a standard female 25 pin miniature "D" type connector. The mating male connector should be an Amphenol type 206771-1 or equivalent. Refer to Figure 4-1 for the location of the serial port on the rear panel.

The Model 930A has been designed to make operation under remote control as much like manual control as possible. There are no opcodes to memorize. Each front panel key function can be activated by a single ASCII character (a keystroke on the terminal or computer keyboard).

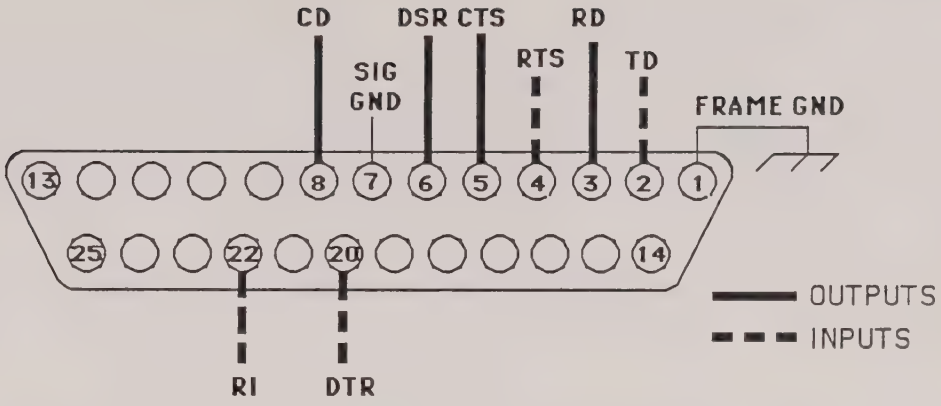
The Model 930A will work with most printers and terminals without modification to cables or reconfiguration of pins. The Model 930A serial interface is configured as Data Communication Equipment (DCE) and wants to "see" Data Terminal Equipment (DTE) connected to it. Since it is emulating a Modem (DCE), most terminals (DTE) can be cabled directly to the Model 930A remote port.

If a computer is being used to control the Model 930A and it has the capability of being either a DTE or a DCE, make sure that it is set to DTE emulation before connecting it to the Model 930A. If the equipment cannot be configured as DTE, then it will be necessary to swap pins 2 and 3 (Transmit and Receive Data). This can be accomplished by using a special cable known as a "NULL MODEM" or a breakout box. The pinouts for the Model 930A connector are shown in Figure 4-2.



RS-232C CONNECTOR LOCATION

FIGURE 4-1



PIN	TO DTE	TO DCE	NAME	FUNCTION
1			FG	FRAME GROUND
2		→	TD	TRANSMITTED DATA
3	←		RD	RECEIVED DATA
4		→	RTS	REQUEST TO SEND
5	←		CTS	CLEAR TO SEND
6	←		DSR	DATA SET READY
7			SG	SIGNAL GROUND
8	←		DCD	DATA CARRIER DETECT
20		→	DTR	DATA TERMINAL READY
22	←		RI	RING INDICATOR

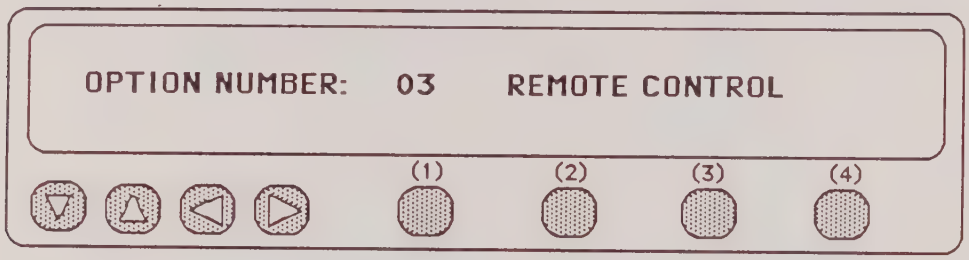
RS-232C CONNECTOR PINOUTS

FIGURE 4-2

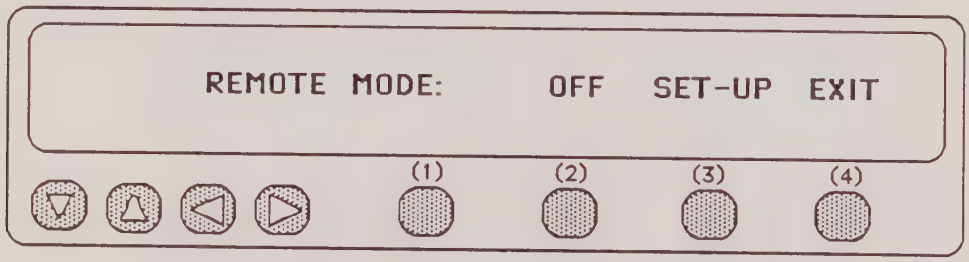
The remaining 15 pins are not connected. Applying a voltage to pins 1 or 7 will cause damage to the 930A. The pinouts shown in Figure 4-2 connect directly to a DTE (Terminal) or printer. For connection to a DCE, a "NULL MODEM" connection, as previously described, must be used.

4-1.1 MODE SELECTION

Once Option 10 has been installed in the 930A, any of the Remote Control modes, including Printer mode, may be selected. To select any of the remote modes press the OPTION MENU key and use the UP/DOWN Arrow keys to go to Option Menu 3. The display will appear as:



Pressing any Softkey will allow the user to enter the option and the display will look like:



If a Remote mode has already been selected, then the current mode will be displayed instead of the word "OFF". Pressing Softkey 2 (labeled "OFF" in the illustration above) selects the Remote Mode. The modes available with Option 10 RS-232C Remote are:

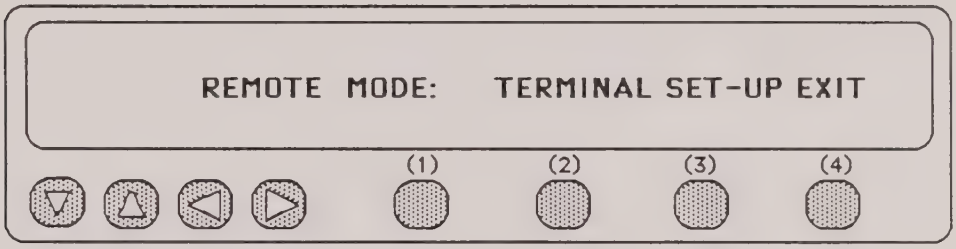
"OFF" ----------Manual control
"TERMINAL" ------- For use with dumb terminals
"COMPUTER" -------For use under computer control
"PRINTER" -------- Used to drive any serial printer connected to the RS-232 serial port.

Other modes which may be displayed, such as MASTER/SLAVE, are intended for use with a Modem (Option 11) or are custom remote modes for a particular customer. Selecting one of these modes will have no effect if they have not been installed in the unit.

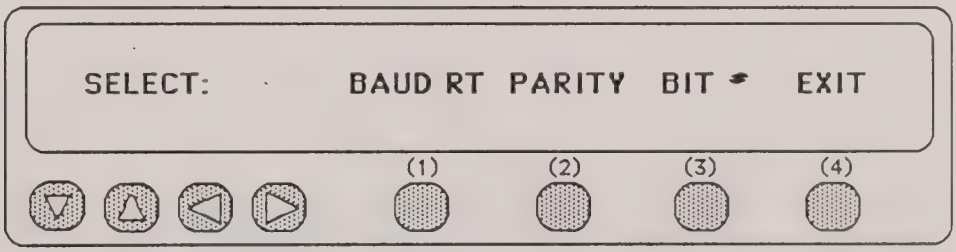
Press Softkey 2 until the desired mode appears. Then press Softkey 4 (labeled "EXIT") and the currently displayed mode will be initialized. Make sure that the current mode is "OFF" if it is desired to operate the 930A in the manual mode. Once the user has selected the correct remote mode, either "TERMINAL","COMPUTER" or "PRINTER", then it is necessary to set up the 930A's interface to match the equipment connected to it. This procedure is described in the next sub-section.

4-1.2 INTERFACE FORMAT SET-UP

When inside Menu Option 3 (REMOTE CONTROL), Softkey 3 is labeled "SET-UP" as shown in the example below:



Pressing Softkey 3 will bring up the set-up menu as shown below:



This "SET-UP" menu is used to examine or adjust the data format of the 930A's asynchronous RS-232C serial interface. This menu enables the user to adjust the baud rate, parity, and number of data bits to match the data format of any Terminal, Computer or Printer which is connected to the 930A. The settings are retained in non-volatile memory and once adjusted need not be changed or examined unless a new item of equipment is to be connected to the 930A. Pressing Softkey 4 exits the menu.

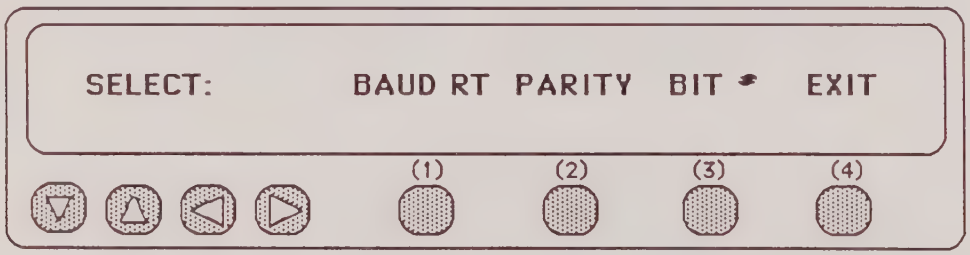
NOTE:

The 930A is factory preset to a data format of 1200 baud, even parity, seven data bits and one stop bit. The 930A will return to this default condition if a "Cold Boot" is performed. Otherwise, the 930A will retain any new settings which the user enters, even when power is turned off, until they are changed by the user.

The following step by step procedure illustrates the set-up of the data format and is applicable to any of the modes.

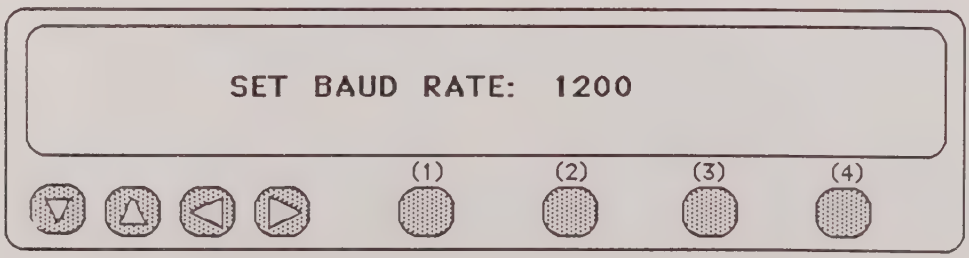
EXAMPLE:

For this example, it is given that the user has gone to Option Menu 3, entered it and pressed Softkey 3 (SET-UP). The display at this point looks like:



With this initial display, the step by step procedures follow as outlined below.

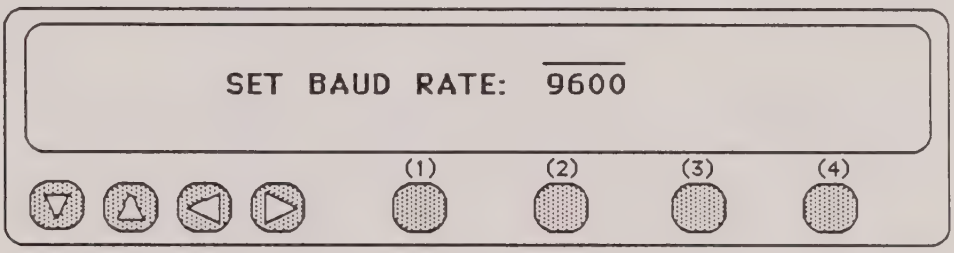
BAUD RATE: To examine or adjust Baud Rate press Softkey 1. The display will appear somewhat like the one shown below (the rate may differ):



In this example, the default value of 1200 baud is used. If this were the desired value, then pressing the ENT (Enter) key or any Softkey would cause this rate to be initialized. If another rate is desired the user can type in the new baud rate using the numeric keypad. Assume that it is desired to operate at 9600 baud. In this case, after Softkey 1 had been pressed, the following sequence of events would be performed using the Numeric keypad:

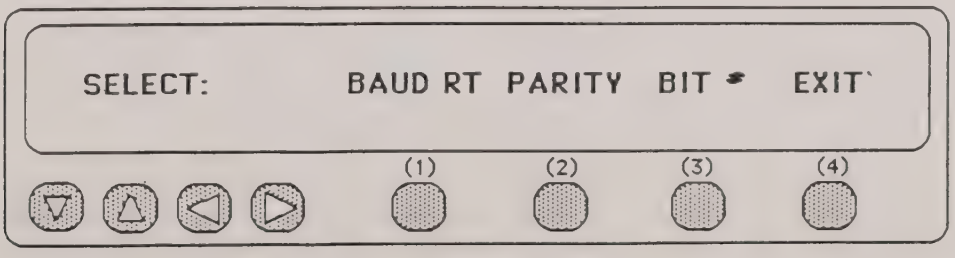
Press [9] then [6] then [0] then [0]

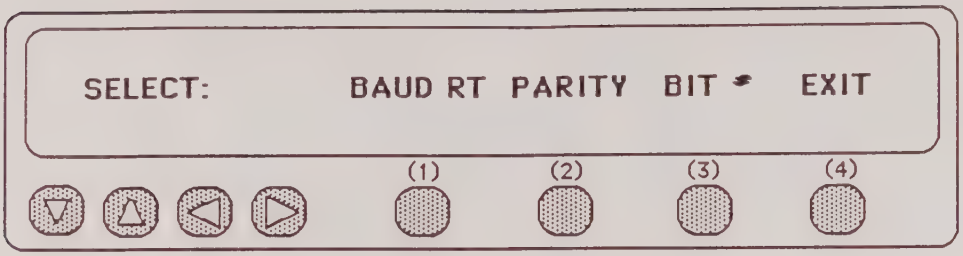
The display of the 930A would then be:



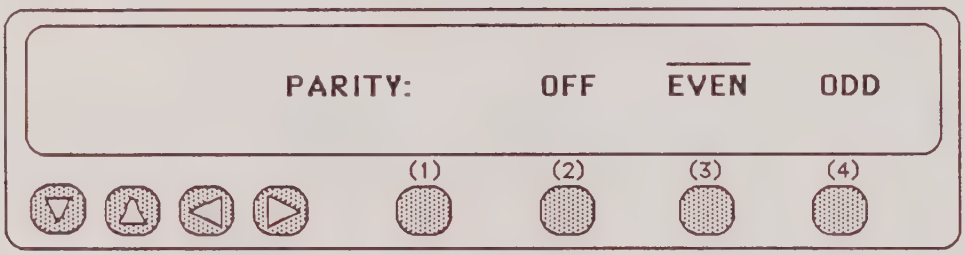
Press [ENT] to enter the rate and return to the Set-Up Menu.

The 930A Set-Up display reappears and the user may now examine or adjust one of the other parameters such as parity. The 930A serial interface supports any baud rate between 110 baud and 9600 baud. The most commonly used baud rates within this range are: 110, 134.5, 150, 200, 300, 600, 1200, 2400, 4800, 7200, and 9600. It is recommended that whenever possible, the operator should use 9600 baud so as to minimize transmission lag.





PARITY: To examine or adjust the parity, press Softkey 2 when in the Set-Up menu (shown above) and the following display will appear:



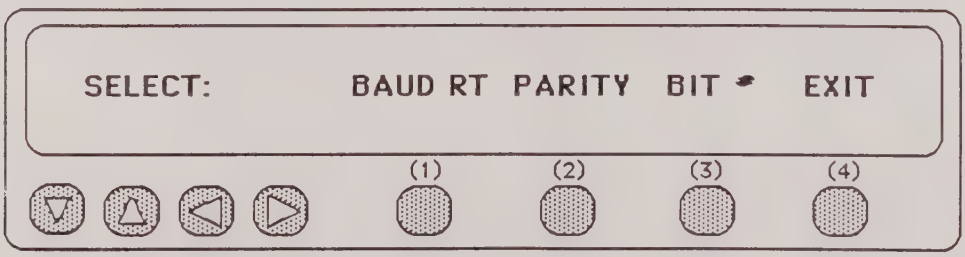
The current parity state will be highlighted (EVEN in this example).

Press Softkey 2 (labeled "OFF") for No Parity

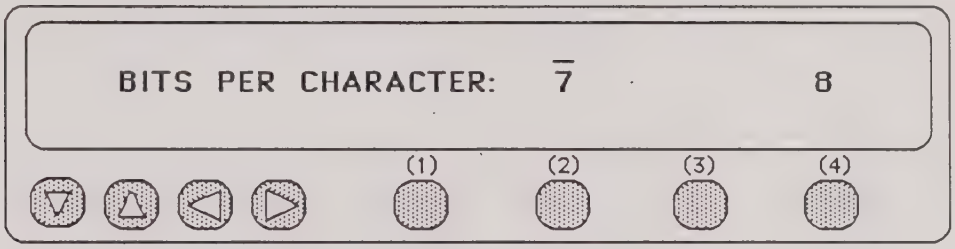
Press Softkey 3 (labeled "EVEN") for Even Parity

Press Softkey 4 (labeled "ODD") for Odd parity

Once the user has pressed the appropriate Softkey, the 930A will immediately initialize that choice and revert to the Set-Up menu for further selections.



DATA FORMAT: The 930A supports ASCII data formats of 7 or 8 bits length and 1, 1-1/2 or 2 Stop bits. To examine or change the currently selected data format, press Softkey 3 when in the Set-Up menu and the following display will appear:

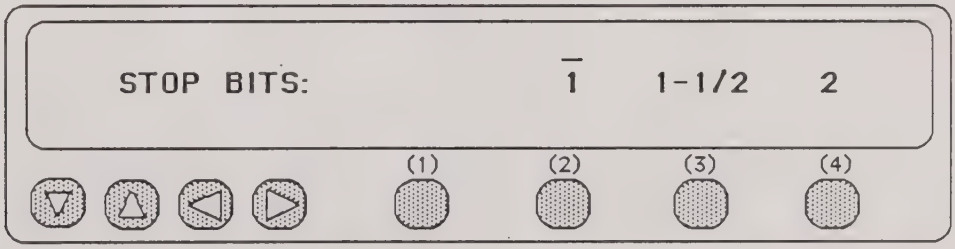


The currently selected number of data bits will be highlighted ("7" in this example).

Press Softkey 2 (labeled "7") to select 7 bit ASCII code.

Press Softkey 4 (labeled "8") to select 8 bit ASCII code.

Once the user has selected the appropriate ASCII word length, the display will advance to read:



The currently selected number of stop bits will be highlighted ("1" in this example).

Press Softkey 2 (labeled "1") to select 1 Stop bit.

Press Softkey 3 (labeled "1-1/2") to select 1-1/2 Stop bits.

Press Softkey 4 (labeled "2") to select 2 Stop bits.

The 930A will automatically return to the Set-Up menu once the user has pressed the appropriate Softkey.

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4-2 PRINTER MODE

4-2.1 INTRODUCTION

One of the most common uses of the Remote Control option is driving a printer from the RS-232C serial port. The Model 930A will work with most commonly available printers provided that the following conditions are met. The printer must have an Asynchronous RS-232C serial input port, print both upper and lower case, be ASCII compatible, and have a carriage width of at least 50 characters (preferably 80 characters). For optimum performance, the printer should accept input at 9600 baud, have at least a 2K buffer and accept continuous feed paper. Sage Instruments currently recommends the Okidata 182 with Super Speed Serial Interface. The user may obtain a printer from Sage by purchasing accessory 9400-0001-01 (80 Column Printer and Cable) if unable to obtain one locally.

Care must be exercised when attempting to use printers which do not have buffers. Such printers must be run at a speed at or below their print speed multiplied by a factor of 10. That is, an unbuffered printer with a print speed of 30 cps must be run at or below 300 baud, and an unbuffered 120 cps printer would have to be run at or below 1200 baud. Hard copy terminals, such as Teletypes and DECwriters, may also be used as printers, but their low speed tends to degrade 930A performance to an undesireable extent.

While the 930A can be connected to most serial printers without modification or special cables, experience has shown that printers vary widely in terms of interface requirements. Some may require special cables or an adaptor, in which case the user may refer back to Figure 4-2 for the pinouts of the 930A serial interface.

4-2.2 PRINT FUNCTION SET-UP

The procedure for setting up the 930A to work with a serial printer is similar to the procedure for setting up any of the remote operating modes. For this reason a brief review of the general set-up procedure follows:

1) Turn on the 930A and set up the correct Trunk Type (Section 3-6) and any test functions desired (Refer to Section 3 as necessary).

2) Press the Option Menu key and page to Menu Option 3 (Remote Control) and set the mode to "OFF" (Refer to Section 4-1.1 as necessary). Exit back to the main Option Menu by pressing Softkey 4 (labeled "EXIT"). This step prevents inadvertently dumping data to the printer and filling up its buffer before the user is ready.

3) Turn on the Printer and connect its cable to the 930A serial port.

4) Press the 930A's Option Menu key and enter Menu Option 3 by pressing any Softkey.

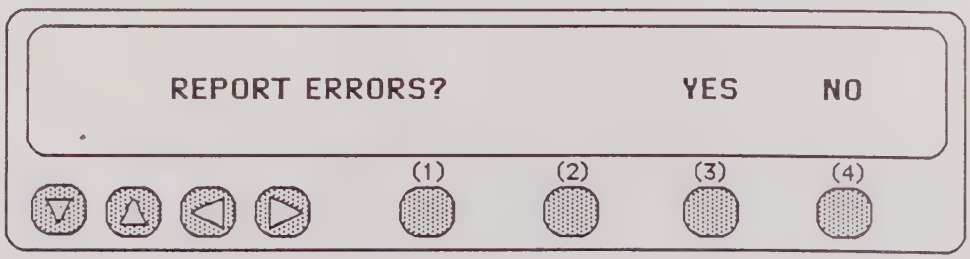
5) Once inside Menu Option 3, press Softkey 3 and enter the Set-Up menu.

6) The data format of the printer should be known or it can be determined by referring to it's operating instructions. Set the 930A's baud rate, parity, character size and stop bits to match those of the printer (Refer to Section 4-1.2 as necessary).

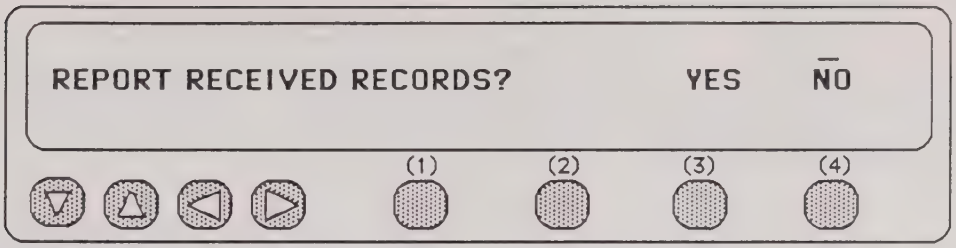
7) Once the data format has been set correctly and the 930A has returned to the Remote Control menu, the operator may use Softkey 2 to select the desired "PRINTER" mode.

8) Exit from the Remote Control menu by pressing Softkey 4 (labeled "EXIT") and the Printer mode will be initialized.

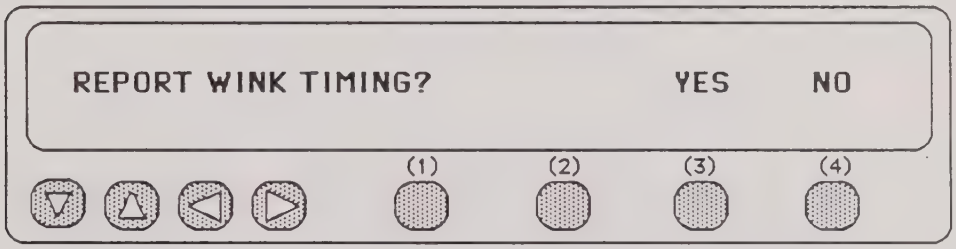
At this point, the user will be asked a series of questions by the 930A regarding what parameters are to be printed out. These questions are:



If the user desires a printout when errors occur then press Softkey 3, otherwise press Softkey 4. In either case the 930A display will advance to the next question, which is:



If a printout of the received records is desired then press Softkey 3, and if not, then press Softkey 4. The 930A display advances to the next question which is:



If it is desired to have a printout of the wink timing parameters press Softkey 3, otherwise press Softkey 4. In each case, the user must choose whether or not to have the 930A print out information on the particular subject. When all three questions have been answered, the printer will begin to print whenever one of the conditions occurs or when the ENT (Enter) key on the 930A is pressed. If it is desired to suspend printing for any reason without taking the 930A out of the Printer mode, simply turn off the printer power. NOTE: Taking the printer "Off Line" may not have the desired effect since it's buffer may fill up with unwanted material which will be printed out when the printer is placed back "On Line".

4-2.3 PRINTER APPLICATIONS

The user may always obtain a hardcopy printout of the 930A display line by simply pressing the ENT (Enter) key. This key rarely affects the display or operation of the 930A.

There are currently three types of information which the 930A can be set to print out spontaneously without a keypress. These are : Errors, Received Records and Wink Timing. As more options become available this list will be expanded. The principles of operation, however, will remain the same no matter how many items are added to the list.

If error reporting is selected, all detected PCM errors will be printed out as they occur. The 930A can be left to monitor a PCM channel overnight and a full error audit will be available in the morning. The list of PCM Error Messages is contained in Section 3-14.2.6.

If received record reporting is selected, received records will be printed out whenever a Receive Records sequence is completed, or whenever the originating end abandons the call (goes On-Hook) in mid-sequence. The 930A can be used to monitor all message traffic on a given PCM channel, or analog trunk, without any human intervention. The number of calls, frequency of inter-LATA vs. intra-LATA calls, and the number of incomplete ANI sequences and abandoned calls can all be determined from the 930A's reports.

If wink timing reporting is selected, wink timing information will be printed out whenever a record sequence is complete, a call is abandoned, or a wink fails. The 930A times supervision events such as winks when it SENDS records or when it receives records in MONITOR mode. When the 930A acts as a terminating digit receiver, it provides the winks rather than timing them. Wink timing printouts can show the time between line seizure and the first wink, the length of all winks, the time between the end of a record and a wink, and the time between call completion and answer supervision. The 930A can monitor these parameters on all calls over a given PCM channel, or analog trunk, completely unattended.

4-2.4 PRINTER REPORT FORMATS

This section provides examples of typical printouts which the 930A might generate for the various types of information. It also provides details of the report formats.

ERROR REPORTS:

An error report is a 40 character string terminated by a line feed and carriage return. The error report will have the following form:

PCM1:	NO PCM!	PCM2:	NO PCM!
	FRAME LOSS		FRAME LOSS
	SLIP		SLIP
	BIPOLAR VIO		BIPOLAR VIO
	REMOTE ALARM		REMOTE ALARM

Description: The label "PCM1:", followed by one blank, the error detected on PCM1 (if any), the label "PCM2:", and the error detected on PCM2 (if any).

RECEIVED RECORD REPORTS:

A report may consist of up to four received records. Each record is a string of 40 characters terminated by a line and feed carriage return. The final record is followed by an additional carriage return and line feed. Each record takes the form:

0123456789#*ABCD0 REC#N HOLD RESET

Description: There is a 17 character record field, followed by the label "REC#", the record number (1-4), three blanks, the word "HOLD", three blanks, and the word "RESET". Dial Pulse records can be digits from 0 to 9. DTMF records can be all digits from 0 to 9 plus the characters "A", "B", "C", "D", "*", and "#". MF records may include, in addition, the characters "KP", "ST", "STP", "ST2P", and "ST3P". There are no spaces between characters and records containing less than 17 characters are preceded by blanks.

WINK TIMING REPORTS:

Wink timing reports will include all completed or interrupted supervision events from the last record sequence received. Each supervision event is sent as three strings. Each string is terminated by a line feed and carriage return. The first string takes the form:

WINK#N

It is six characters in length and all supervision events (Winks, Off-Hooks, and Delays) are preceded by this string. The second string takes the form:

W 01 W 02 03 W H	NNNN MSEC	GUARD
(any sequence)	>16,000 MSEC	
	>60,000 MSEC	

The record sequence is printed first and may be up to 17 characters long (shorter sequences are preceded by blanks). Next, the length of the Guard period in milliseconds, or a time-out indicator, followed by the word "GUARD" is printed out. This string is 40 characters long. The third string takes the form:

W 01 W 02 03 W H	NNNN MSEC	WINK
(any sequence)	>600 MSEC	OFF-HOOK
	>200 MSEC	DELAY
	FAILED	

The record sequence is printed first, and may be up to 17 characters long (shorter sequences will be preceded by blanks). Next, the length of the event in milliseconds, or a time-out or failure indicator, followed by an event type label is printed out. This string is also 40 characters long. The final supervision event in the report is followed by an additional line feed and carriage return.

NOTE: If more than one type of data is included in an output, the 930A will print them out in the following order: Errors, Received Records and then Wink Timing.

4-3 OPERATION IN THE TERMINAL MODE

The Model 930A currently supports the Televideo family of terminals (the Televideo 910, 910+, 912, and 925) and those terminals which can be set to emulate Televideo such as ADM, WYSE, and Hazeltine to name a few. These are so-called "Dumb" terminals, as distinguished from intelligent terminals, and are relatively inexpensive. The terminal types which the 930A will operate with will expand in the future as customer needs change. The 930A does not currently support teletypes or other "hard copy only" terminals such as DECwriters, except as Printers (Refer to Section 4-2 for details).

4-3.1 TERMINAL SET-UP

To use the Model 930A from a terminal, follow the standard set-up procedure outlined in Section 4-1.2 INTERFACE FORMAT SET-UP and Section 4-2.2 PRINT FUNCTION SET-UP. The procedure for setting up the data format of the 930A's serial port is identical for all remote modes. The steps again, in brief, are: Set the 930A Remote Mode to "OFF", connect the terminal, set the 930A's baud rate, parity, character size, and stop bits to match the terminal's data format, set the 930A's Remote Mode to "TERMINAL" and press Softkey 4 (labeled "EXIT"). The display which should appear on the CRT will be somewhat like that shown in Figure 4-3 below.

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SAGE INSTRUMENTS 930A

------------------------------------------------

NORMAL LOOP  TERM  CONTACT  2W 900   o    t  (Current Trunk Type)
      [ J ] [ K ]   [ L ]     [ ; ]  ORIG TERM
------------------------------------------------
A) TRUNK TYPE
B) DIAL/RING
C) RETURN LOSS
D) SEND TONE
E) MEAS TONE
F) MEAS NOISE
G) OPTIONS

UPPERCASE  O) GO OFF HOOK    ?) HELP    CR) ENTER    SP) CLEAR
Lowercase  o) GO ON HOOK     S) STO      R) RCL      N) RCL NEXT

When sending digits:
To send: 0 1 2 3 4 5 6 7 8 9 - KP ST STP ST2P ST3P +/-
  Type: 0 1 2 3 4 5 6 7 8 9 - *  #  a   b    c    d
```

TERMINAL CRT DISPLAY
FIGURE 4-3

NOTE: The line marked "Current Trunk Type" will show the trunk type currently selected in the 930A.

4-3.2 TERMINAL KEYS

The keys on the Terminal which affect the 930A are listed on the Terminal CRT screen together with their functions as shown in Figure 4-3. Note that each front panel key on the 930A is represented by a single key on the terminal keyboard. Pressing one of the Terminal keys, with the 930A in Terminal mode, has the same effect as pressing the equivalent key on the 930A itself. A more detailed description follows:

930A FUNCTION KEYS:

Uppercase "A" is the TRUNK TYPE key
Uppercase "B" is the DIAL/RING key
Uppercase "C" is the RETURN LOSS key
Uppercase "D" is the SEND TONE key
Uppercase "E" is the MEASURE TONE key
Uppercase "F" is the MEASURE NOISE key
Uppercase "G" is the OPTION MENU key

SOFTKEYS:

Uppercase "J" is Softkey 1
Uppercase "K" is Softkey 2
Uppercase "L" is Softkey 3
Semicolon " ;" is Softkey 4

(Note that these keys are in line on the terminal keyboard----- "J", "K", "L", ";" just like Softkeys 1, 2, 3, and 4 on the 930A.)

SPECIAL FUNCTION KEYS:

Question Mark "?" is the HELP key
Carriage Return (CR) is the ENTER key
Space Bar is the CLEAR key
Uppercase "S" is the STORE key
Uppercase "R" is the RECALL key
Uppercase "N" is the RECALL NEXT key

HOOK SWITCH:

Uppercase "O" causes the 930A to go "Off-Hook"
Lowercase "o" causes the 930A to go "On-Hook"

ARROW KEYS:

The Up, Down, Left, and Right cursor keys on the Terminal correspond directly to the Up, Down, Left, and Right Arrow keys on the 930A.

NUMERIC KEYPAD:

The number keys 0 through 9 on the terminal correspond directly to the number keys on the 930A numeric keypad.

The Terminal's star key "*" sends DTMF "*", or MF "KP"
The Terminal's pound key "#" sends DTMF "#", or MF "ST"
Lowercase "a" is used to send DTMF "A", or MF "STP"
Lowercase "b" is used to send DTMF "B", or MF "ST2P"
Lowercase "c" is used to send DTMF "C", or MF "ST3P"
Lowercase "d" is used to send DTMF "D"
Lowercase "d" is also used as the change sign "+/-"

Further details of the keyboard input including ASCII to HEXADECIMAL and ASCII to Decimal code equivalents are contained in Section 4-4 COMPUTER OPERATION.

4-3.3 TERMINAL CRT DISPLAY

Most of the CRT is dedicated to displaying a HELP screen. Only one line of the CRT changes to indicate the status of the 930A and it is set off from the others by a dotted line. It always echoes the display on the 930A front panel. In the example of Figure 4-3 the line was:

```
-------------------------------------------------------
NORMAL LOOP   TERM   CONTACT   2W 900   o     t   (Current Trunk Type)
```

The "[J] [K] [L] [;]" below the changing display line in Figure 4-3 is meant to reflect the position of the four Softkeys under the 930A front panel display. The equivalent keys on the terminal ("J", "K", "L", and ";") line up below the functions just as Softkeys 1-4 do on the 930A. A Softkey's function is usually indicated by the display above it. The entire display line, using Figure 4-3 as an example, looks like:

```
-------------------------------------------------------
NORMAL LOOP   TERM   CONTACT   2W 900   o     t   (Current Trunk Type)
      [ J ]  [ K ]  [ L ]     [ ; ]  ORIG TERM
-------------------------------------------------------
```

A portion of the display line has the words "ORIG" and "TERM" beneath it.

These fields show the condition of the 930A's supervision lamps. The lowercase "o" and "t" in the display above indicate that both the originating and terminating ends are "On Hook". An uppercase "O" or "T" indicates an "Off Hook" condition at the originating or terminating end. A "-" in either location means "no indication", and generally signifies an incomplete or faulty circuit.

4-3.4 TROUBLESHOOTING

SYMPTOM: Terminal CRT remains blank.
PROBABLE CAUSE: Faulty or improper RS-232 cable connection.
APPROACH: Check cables, power to the terminal, and RS-232 pinouts.

SYMPTOM: Terminal prints gibberish.
PROBABLE CAUSE: Incorrect data format.
APPROACH: Turn terminal off. Set 930A Remote Mode to "OFF". Check 930A baud rate, parity, character size, and stop bits. Check terminal DIP switches to be sure of it's data format. Turn terminal on. Set the 930A remote mode to "TERMINAL" and press Softkey 4 to "EXIT".

SYMPTOM: The 930A does not respond to terminal commands.
PROBABLE CAUSE: Bad mechanical connection or CAPS LOCK not down.
APPROACH: For mechanical condition, check the cables and connectors (broken pins), power, and RS-232 pinouts. For CAPS LOCK be sure that Uppercase commands are being sent when intended. The 930A uses only a few lowercase commands so the CAPS LOCK key on the terminal should generally be down.

SYMPTOM: 930A responds to some commands but not others.
PROBABLE CAUSE: Broken lead in RS-232 cable or wrong data format.
APPROACH: For data format, refer back to the "gibberish" symptom. Test the RS-232 cable with an ohmmeter or by replacing with another cable.

CAUTION: DO NOT USE TERMINAL AUTO-REPEAT MODE TO SEND DATA TO THE 930A. The "auto-repeat" of keys that are held down can rapidly overfill the 930A's command buffer. Even after the key is released there will be forty characters left to process in the buffer.

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4-4 COMPUTER OPERATION

4-4.1 INTRODUCTION

The 930A can be operated under the control of any computer capable of sending and receiving serial ASCII characters over an RS-232 link. Each character sent to the 930A is treated as a keystroke from the 930A's front panel. A single ASCII character has been selected to represent each key on the front panel of the 930A. Sending the ASCII character is the equivalent of pressing the 930A key associated with it. For example, sending the Uppercase ASCII character "A" is the same as pressing the Trunk Type Function key. Writing a program for the 930A is just like writing a program for a programmable calculator. That is, do the operation manually and write down the key sequence. Then translate the key sequence into an ASCII string. Sending the string causes the operation to be performed. Refer to Table 4-1 for ASCII to front panel conversions as well as HEX and Decimal equivalents.

It is strongly recommended that the Terminal mode be used when writing or debugging programs intended for use in the Computer mode. Terminal mode is fully interactive and comes with onscreen HELP.

There are a few ASCII characters (W, X, Y, and Z) that will cause the 930A to perform special functions that are only performed remotely. These characters do not correspond to any keys on the 930A front panel. Refer to Table 4-2 for details.

TABLE 4-1
ASCII TO FRONT PANEL KEY CONVERSION

ASCII CHARACTER	930A FUNCTION	HEX CODE	DECIMAL CODE
A	Trunk Type	41	65
B	Dial/Ring	42	66
C	Return Loss	43	67
D	Send Tone	44	68
E	Measure Tone	45	69
F	Measure Noise	46	70
G	Option Menu	47	71
RETURN	Enter	0D	13
SPACE	Clear	20	32
?	Help	3F	63
S	Store	53	83
R	Recall	52	82
N	Recall Next	4E	78
d	Change Sign (+/-)	64	100
-	Pause	2D	45
Uppercase O	Go Off Hook	4F	79
Lowercase o	Go On Hook	6F	111
J	Softkey 1	4A	74
K	Softkey 2	4B	75
L	Softkey 3	4C	76
;	Softkey 4	3B	59
(Left Cursor)	Left Arrow	08	8
(Right Cursor)	Right Arrow	0C	12
(Up Cursor)	Up Arrow	0B	11
(Down Cursor)	Down Arrow	0A	10

TO SEND	TYPE	HEX	DEC	TO SEND	TYPE	HEX	DEC
0	0	30	48	*	*	2A	42
1	1	31	49	#	#	23	35
2	2	32	50	A	a	61	97
3	3	33	51	B	b	62	98
4	4	34	52	C	c	63	99
5	5	35	53	D	d	64	100
6	6	36	54	KP	*	2A	42
7	7	37	55	ST	#	23	35
8	8	38	56	STP	a	61	97
9	9	39	57	ST2P	b	62	98
				ST3P	c	63	99

TABLE 4-2
SPECIAL ASCII CHARACTERS FOR REMOTE CONTROL

CHARACTER	FUNCTION	HEX	DEC
W	Causes the 930A to report all pending PCM errors, received records, and wink timing information to the host computer. Information is "pending" when an ALERT has been sent but no REPORT has been requested.	57	87
X	Interrupts the 930A and causes it to send an immediate copy of it's current display line to the host computer. This command is not buffered and executed in turn. It is executed at once.	58	88
Y	Causes the 930A to send a copy of it's current display line to the host computer. This command is buffered and executes after all previous commands have been completed.	59	89
Z	Causes the 930A to send a copy of it's current display line after it determines that a valid measurement has been made. A series of consecutive "Z" commands will cause the 930A to send consecutive measurements to the host computer.	5A	90

NOTES:The "X", "Y", and "Z" commands all cause the 930A to send a copy of it's display line to the host computer.

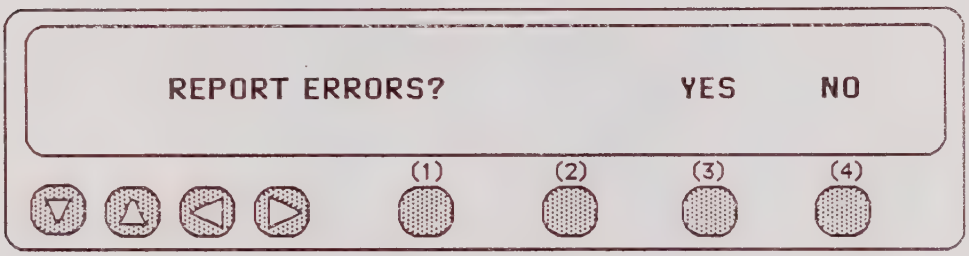
The "X" command executes immediately and can be used to find the current status of the 930A. This allows "spot checking" progress through a command sequence at any time.

The "Y" command tells the 930A to send a copy of it's display line when it reaches a certain point in the command sequence. This can be used to obtain a measurement or start a timer in the host.

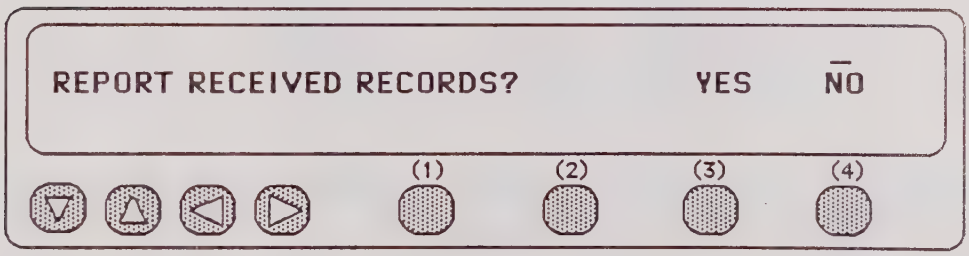
The "Z" command is like the "Y" command, except that successive "Z" commands will each be delayed by one measurement period.

4-4.2 COMPUTER MODE SET-UP PROCEDURE

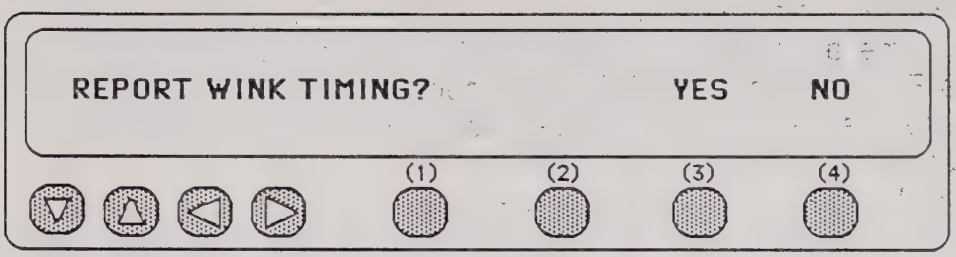
The RS-232 interface set-up procedure for the Computer Mode of the 930A is the same as outlined in Sections 4-1.2 and 4-2.2. To review: set the 930A's Remote Mode to "OFF". Connect the computer to the 930A serial port. Use the Set-Up menu to set the 930A's baud rate, parity, character size, and stop bits. Set the Remote Mode to "COMPUTER" and press "EXIT". The 930A will ask the following questions:



Press Softkey 3 if it is desired to have the 930A alert the host computer when it detects PCM errors. Press Softkey 4 if no alert for PCM errors is required. The display will advance to the next question:

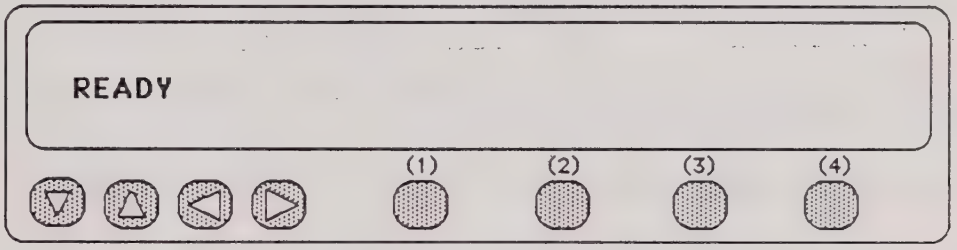


Answer Yes by pressing Softkey 3 if it is desired to have the 930A alert the host computer upon completion or interruption of a Receive Record sequence. Otherwise, press Softkey 4. The 930A display automatically advances to the next question.



Answer Yes by pressing Softkey 3 if the 930A is to alert the host computer when it has wink timing information available. Otherwise press Softkey 4.

The 930A display should then read:



A prompt will then be sent to the host computer to indicate that the 930A's command buffer is empty and the 930A is awaiting instructions.

4-4.3 INPUT TO THE 930A

Input to the 930A is in the form of "command strings". These are strings of ASCII characters that the 930A recognizes as commands. A command string may be from 1 to 40 characters in length. The 930A has a 40 character input buffer. Tables 4-1 and 4-2 contain summaries of these commands and Section 4-3.2 describes them.

The 930A will echo each character back to the computer as it is received and placed in the buffer. DO NOT SEND THE NEXT CHARACTER UNTIL THE ECHO HAS BEEN RECEIVED. This is the 930A input protocol (actually a handshake).

The 930A will execute the commands in the order they are received, with the exception of the "X" character which executes immediately. When all of the received commands have been executed, and the input buffer is empty, the 930A will signal the host computer with a prompt.

The 930A will echo and ignore any characters it does not recognize as commands. No error message is sent back.

4-4.4 OUTPUT FROM THE 930A

Output from the 930A consists of the following:

ECHOES --- The 930A echoes all received characters to the host computer.

PROMPTS - When the 930A has executed all received commands, and its command buffer is empty, it sends a prompt consisting of a line feed, carriage return, and a ">" character. The ASCII sequence in Hexadecimal code is 0A 0D 3E. Some data strings include the ">" character, but the 0D 3E sequence is unique.

ALERTS -- Under certain circumstances, the 930A will send a "bell" character (ASCII 07) to alert the host computer that it has something to report. Any programs the user writes should screen all 930A output carefully for this character.

DATA ---- When the 930A executes an X, Y, or Z command, it sends a copy of it's current display line and supervision status. This is a 50 character line terminated by a line feed and carriage return. Section 4-4.5 contains details of display line formats.

REPORTS- If the 930A has sent the host computer an ALERT, it will caused the ALERT. This could be a PCM error, a completed Receive Record sequence, Wink Timing information, or some combination of the three. Section 4-4.5 contains further details of Report Formats.

4-4.5 DISPLAY LINE FORMATS

A Display Line is always 50 characters long terminated by a line feed and carriage return. The first 40 characters of a Display Line mirror the display on the front panel of the 930A. The next 4 characters are ASCII blanks. The forty-fifth character shows originating supervision. The next 4 characters are ASCII blanks. The fiftieth character shows terminating end supervision. Typical displays which might show up on the computer's CRT screen are provided as examples.

TYPICAL CRT DISPLAYS:

MEASURE TONE:

NNNN Hz	+NN.N dBm0	PCM1	BRIDGE	O	T
----	OVER dBm	PCM2	TERM	o	t
	---- dB	T1R1		-	-
		TR			

Description --- Seven leading blanks, followed by the frequency in Hertz or four dashes, the label "Hz ", a signed level or the over or under indication ("OVER" or "----"), the relative zero label, the signal source label, and the termination label.

MEASURE NOISE:

+NNN	dBrn0	C-NOTCH	PCM1	CHANNEL	O	T
	dBrn	3K FLT	PCM2	N-TO-G	o	t
	dB	C-MSG	T1R1	BAL	-	-
			TR			

Description --- Three leading blanks, followed by a signed level measurement, the relative zero label, the filter type, the signal source label, and the type of measurement.

RETURN LOSS:

4 WIRE:

+NNNdB	SRL LO NNNNHz	+NN THL 4W 1200	O	T
	SRL HI	4W 900	o	t
	ERL	4W 600	-	-
	OSC	PCM1		
		PCM2		

Description --- Two leading blanks, followed by a signed level measurement and the label "dB", the signal type, the frequency of the echo suppress tone or the oscillator tone, a signed trans-hybrid loss level and the label "THL", and a trunk type label.

2 WIRE: -- NORMAL:

+NNNdB	SRL LO NNNNHz	2W 1200	O	T
	SRL HI	900	o	t
	ERL	600	-	-
	OSC	150		

Description --- Two leading blanks, followed by a signed level measurement and the label "dB ", the signal type, the frequency of the echo suppress tone or oscillator tone, ten blanks, and a trunk type label.

2 WIRE: -- TR TERM:

TR TERM	AC SHORT 2W	O	T
	AC OPEN	o	t
	900+2.16	-	-
	600+2.16		

Description --- 9 leading blanks, followed by the label "TR TERM" and an additional 8 blanks, a circuit descriptor label, and the "2W" descriptor with 9 trailing blanks.

In the previous examples of typical CRT displays, the numerical data format needs to be explained in more detail. That is, numbers were denoted by a single "N" for each possible digit with the understanding that this "N" was showing location rather than numerical value. In point of fact, each "N" could stand for any number. If a decimal point were present, it was shown as a "." . Signed numbers were shown being preceded by a "+" character. In practice, this could be either a "+" or "-".

Leading zeroes will be printed as blanks and trailing zeroes will be printed as zeroes. The digit to the left of the decimal point will always be printed, even if it is a leading zero. The sign of the number will always be printed to the left of the first non-blank digit.

For example: A number which was represented by "+NN.N" in the above typical displays could be any of the following in actual practice:

+99.9, -1.0, +0.0, -0.4, +7.4

4-4.6 PROGRAMMERS NOTES

This Section is currently under review and will be supplied at a later date.

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